Form 2014

CHEM 124
LABORATORY SKILLS EXAMINATION

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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 part(s) 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 and they may be performed in any order. *It's always a good idea to use a computer whenever one is free if parts I, IV, or V are assigned* (due to equipment limitations they will not all be assigned at the same time).

Do not monopolize the use of a computer when others are waiting. Prepare all solutions first, before starting to use the computer.

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. Work in a timely fashion. You may repeat any part if you are uncertain of your results (assuming you have unknown left); however, 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 and checkout)!!

5.   You will have access to all necessary equipment. As well as the equipment in your own drawer, you wlll have access to burets, 100-mL volumetric flasks and pipets. Spectrometers, transformers, pH electrodes, and temperature probes will be available if needed.

6. 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*.

You will receive approximately the following amounts of unknowns:

Part I: 15 mL of unknown copper acetate solution (blue).

Part II: 40 mL of unknown salt solution (colorless).

Parts III: unknown electrode.

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Part IV: no unknown.
Part V: test tube containing unknown solid.
Part VI: 15 drops of unknown cation(s).

7. Turn in the Report Sheet and the items specifically listed below. Record all values in ink. You may append other materials (data, calculations, …) if you wish. Attaching sample calculations for all starred items on the report sheet may allow some partial credit to be awarded. *However, there will be very significant deductions for incorrect calculations.*   There is no guarantee that any other appended material will be reviewed when the report is graded.

EXPERIMENTAL SECTION

Work Individually. Do only the parts assigned by your instructor

Part I. (10 points) Use of a Spectrometer

The objective of this part is to test your ability to prepare a solution and use a spectrometer.

Reagents provided:
    0.300 M $Cu(C_2H_3O_2)_2$(aq).
    $Cu(C_2H_3O_2)_2$(aq) unknown solution.

Tasks to be accomplished:

1. Prepare a 0.0300 M $Cu(C_2H_3O_2)_2$(aq) solution from the 0.300 M solution provided.

2. Obtain an unknown $Cu(C_2H_3O_2)_2$(aq) solution from the instructor.

3. Measure the absorbance spectrum for the 0.0300 M solution and use it to determine the wavelength of maximum absorbance, λ_{max}.

4. Measure the absorbance of the 0.0300 M solution and the unknown solution at λ_{max}.

5. Calculate the molar absorptivity of $Cu(C_2H_3O_2)_2$(aq) at λ_{max}.

6. Calculate the concentration of your unknown solution from its absorbance.

Your waste solutions should be discarded in the appropriate waste bottle in the hood.

Results to report:

1. λ_{max} (2 pts).

2. The absorbances of the two $Cu(C_2H_3O_2)_2$(aq) solutions at λ_{max} (4 pts).

3. The calculated molar absorptivity at λ_{max} (2 pts).

4. The concentration of your unknown (2 pts).

Part II. (10 points) Determination of Density

The objective of this part is to test your ability to perform a routine lab analysis and use a pipet.

Reagent provided:
    salt solution of unknown concentration

Tasks to be accomplished:

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

2. Measure the density of your unknown as precisely as possible.

Your waste can go down the drain.

Result to report:

1. The density of your unknown in g/mL (10 pts).

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Part III. (10 points) Electrolysis

The objective of this part is to test your ability to carefully conduct and electrolysis experiment and identify the oxidation state of a metal ion.

Reagents provided:
  0.20 M H_2SO_4(aq)
  Wire Electrodes, 50-mL burets
  Wires, power supplies, and current meters
  Unknown metal electrodes

Tasks to be accomplished:

1. Construct an electrolysis setup similar to that used in the Electrolysis experiment.

2. Weigh your unknown electrode.

3. Using a current of about 0.3 – 0.5 A, collect about 20 mL of gas.

4. Weigh the unknown electrode.

5. Calculate the moles of electrons that passed through the circuit.

6. Calculate the moles of metal oxidized (the molar mass of your unknown will be provided).

7. Divide the moles of e⁻ by the moles of metal to get the # of e⁻ released per metal ion formed.

Dispose of all solutions in the designated waste containers.

Results to report:

1. The mass of metal electrode oxidized (4 pts).

2. The moles of e⁻ that passed through the circuit (2 pts).

3. The moles of metal oxidized (2 pts).

4. The # of e⁻ released per metal atom (2 pts).

Part IV. (10 points) Solution Preparation and Measurement of pH & Buffer Capacity

The objective of this part is to test your ability to prepare a buffer solution, and to measure its pH and buffer capacity.

Reagents provided:
  Acetic acid, $HC_2H_3O_2$(aq), 0.100 M.
  Sodium acetate, $NaC_2H_3O_2$(aq), 0.100 M.
  NaOH(aq), roughly 0.05 M. Check the bottle in lab for the actual concentration.

Tasks to be accomplished:

1. A volume of sodium acetate will be assigned for you to use. Get this value from the instructor.

2. Prepare a buffer solution by adding 10.0 mL of 0.100 M acetic acid and the assigned volume of the 0.100 M sodium acetate to 20.0 mL of water. So the total volume of buffer equals 30.0 mL + assigned volume of sodium acetate.

3. Measure the pH of your buffer solution. You can choose how much of your buffer to use in the analysis: 10 mL (as in expt 9), or all of it.

4. Measure the buffer capacity of the buffer solution you have prepared. (You may choose to use part or all of your buffer solution. Record the volume of *buffer solution* you use on your report sheet.)

Your waste can go down the drain.

Results to report:

1. The pH of the prepared buffer solution (3 pts)

2. The volume of buffer solution you chose to use when determining the buffer capacity.

3. The measured volume of NaOH needed to change the pH by 1 unit (5 pts).

4. Your calculated buffer capacity (2 pts).

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Part V. (10 points) Freezing-Point Depression

The objective of this part is to measure the freezing-point depression for an unknown solid and to determine its effective molar mass.

Reagents provided:
   Unknown solid

Tasks to be accomplished:

1. Obtain a test tube containing an unknown solid from the instructor.

2. Measure the freezing-point of water using your temperature probe.

3. Prepare a solution using about 2 g of unknown solid and 20 mL of water.

4. Measure the freezing point of the solution and the mass of solution.

5. Using K_f for water and the measured freezing point depression, calculate the molality of your unknown solution. (You may assume that $i = 1$.)

6. From the mass of solvent and the calculated molality, calculate the moles of unknown solute.

7. From the mass of solid used and moles of solute calculated, determine the molar mass of the unknown.

Your waste can go down the drain.

Results to report:

1. The measured freezing point of water (1 pt).

2. The measured freezing point of your unknown solution (4 pts).

3. The measured mass of solid used.

4. The measured mass of solution formed.

5. The molality of your solution (2 pts).

6. The calculated moles of solute (2 pts).

7. The calculated molar mass (1 pt).

Part VI. (10 points) Qualitative Analysis

The objective of this part is to test your ability to perform qualitative analysis by identifying the cation(s) in an unknown solution.

Reagents provided:
   All reagents available during the qualitative analysis experiment will be available.

Tasks to be accomplished:

1. Obtain 15 drops of unknown cation solution from the instructor.

2. Determine the identity of the cation(s) in your unknown. There will only be one or two different cations in each unknown.

Discard your waste in the appropriate waste bottles in the hood.

Result to report:

1. The identity of your cation(s) (10 pts).

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Name _____

Chemistry 124 Lab Final Report Sheet   Form 2014

All values should be reported to the proper number of significant figures and with appropriate units.
You may attach a sheet with sample calculations in order to receive partial credit for all starred (*) items.

Part I: Spectrophotometry

       $Cu(C_2H_3O_2)_2$ Unknown Number: _____

       λ_{max} (2): _____

       Absorbance of 0.0300 M solution at λ_{max} (2): _____

       Absorbance of Unknown at λ_{max} (2): _____

       *Molar Absorptivity at λ_{max} (2): _____

       *Concentration of Unknown (2): _____

Part II: Density

       Salt Solution Unknown Number: _____

       *Density of Unknown (10): _____

Part III: Electrolysis

       *Mass of Electrode Oxidized (4): _____

       *Moles of Electrons (2): _____

       *Moles of Metal Dissolved (2): _____

       *Average Number of Electrons Released Per Metal Ion Formed (2): _____

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Part IV: Buffer Capacity

Assigned Volume of Sodium Acetate: _____

Measured pH (3): _____

Volume of Buffer Solution Used: _____

Volume of NaOH Used (5): _____

*Buffer Capacity (2): _____

Part V: Freezing Point Depression

Solid Unknown Number: _____

Measured Freezing Point of Water (1): _____

Measured Freezing Point of Solution (4): _____

Mass of Solid Used: _____

Mass of Solution Measured: _____

*Calculated Molality of Solution (2): _____

*Calculated Moles of Solute (2): _____

*Calculated Molar Mass (1): _____

Part VI: Qualitative Analysis

Cation Unknown Number: _____

Cation(s) Present (10): _____

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