Chemistry 125/126
General Chemistry - Inorganic Laboratory
Spring 2008

COURSE INFORMATION (See additional information, pp.214-228 in course lab manual)

Course information is available on the world wide web: http://www.umich.edu/~chem125

Course Coordinator and Lecturer	Office	Office Hours
Nancy Konigsberg Kerner	3541	M and W 11am -noon *Phone :763-5372* *e-mail: nkerner@umich.edu*

Chemistry 125 and 126 are 1-credit co-requisites that comprise the same coursework formerly associated with the 2-credit Chem. 125 course. For grading purposes, these courses are dependent co-requisites. Students will only earn credit in Chem. 126 by completing Chem. 125, and vice versa. The grade earned in one of these courses will be earned in the other.

GSIs (TBA)

Lang Ming	minglang@umich.edu	section 112/113
Jenna Welby	jwelby@umich.edu	section 110/111
Noah Gardner	npgardner@umich.edu	section 114/115

Overrides and wait lists:

Report to the chemistry department's administrative office (1500 chem)

Lectures

Lectures occur prior to the start of a new topic and experiment. Refer to the course schedule (below) for specific dates and topics.

Discussions

Refer to the discussion information provided in the lab manual, p.226 for information regarding discussion issues such as absence, late arrival and grading. Discussions occur after the completion of an experiment and before the start of a new topic and experiment. Refer to the course schedule (below) for specific discussion dates and times.

Exams

There will be one term exam on Monday, June 16, noon – 2 pm.
Sample exams are provided on the course web site: http://www.umich.edu/~chem125/

Required Course Materials

Lab Manual: Konigsberg Kerner, N., and Penner-Hahn, J., Collaborative Investigations in Chemistry, Hayden McNeil Publishing, Inc., Winter 2008

Supplies: Marking pen for labeling tape on glassware

Safety and Special Needs.

Special safety problems? Contact Richard Giszczak (1608 chem; richg@umich.edu).
Special needs (e.g. large print exams or ?) Contact Nancy Kerner (3541 chem.; nkerner@umich.edu).

COURSE METHODS

Chemistry is an experimentally based science. We know what we know because scientists have made experimental observations that have led to fundamental understandings and principles regarding the properties and reactivity of matter. The experiments in this manual will involve you in the process of looking for property or reactivity data patterns to solve problems.

You will conduct "inquiry" experiments where you are *not* expected to know the outcome in advance. Inquiry consists of 3 phases – exploration, organization, and application. During exploration you will gather data in order to solve a problem. During the organization phase you will manipulate the data to look for patterns. During the application phase you will apply the results to the problem under investigation and make predictions about untested samples or real life situations.

During this laboratory-centered course you will use qualitative reasoning skills that scientists use when solving problems such as formulating hypothesis, organizing data, making inferences from data, and designing experiments. You will do most of your experiments in a group where you will combine and compare data, instead of competing with classmates for the "right" answer.

You don't need lab experience to do well in Chemistry 125/126. You *do* have to: prepare in advance for the labs; attend your laboratory section and work conscientiously and safely during the period; think about the experiments that you have done; and prepare in advance for the discussion. If you do these things, you should be able to get at least a B grade for the course.

Report Information and Turn in directions (Spring 2008).

You will be required to turn in an individual pre-lab report at the start of each new experiment and a team report at the conclusion of each experiment. The team report form provided in the manual is merely a fill-in the blank outline and does not state all the questions you need to answer. For maximum points on the team report, you need to respond to all directives and questions within the experiment itself and include specific examples from the data to support your conclusions.

	When?	Team vs. Individually	Where?	Comments
Pre lab report	Due at start of new experiment	Individually	Hand to GSI entering lab	
Team lab report	Due upon completion of experiment or as announced	Team – One copy per team	In lab or in GSI mailbox in basement under the stairs in the atrium	- Don't forget to print the class data before leaving lab - ALWAYS use SPECIFIC examples from the data to support answers!
Discussion (Presentation+Abstracts)	Abstract due upon completion of experiment .		In discussion or lab room after the lab is done	Share abstract for question with GSI and team in lab or via email

ABSENCE AND MAKE-UPS

Since the course is cumulative it is important that you not miss a lab. Occasionally, circumstances will arise that force you to miss a lab. During spring term there are few scheduled labs and it may therefore not be possible to schedule a make-up outside the normally scheduled lab hours. If you miss the last scheduled lab prior to check out, it will only be possible to schedule a make-up during Fall term 2008.

TEAM ASSIGNMENTS SPRING 2008

Team Discussion Question Assignments Spring 2008

Team	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5	Experiment 6
1	1	**3**	5	2	4	TBA
2	2	1	**4**	3	5	TBA
3	3	4	1	**5**	2	TBA
4	4	5	2	**1**	**3**	TBA
5	5	**2**	3	**4**	1	TBA
6						

Team Assignments Experiments 1 – 3 Spring 2008

Team	E 1 Part I Solution #	E 1 Part 4	E 2 Part 2	E 2 Part 3	E 2 Part 4	E 3 Part IB
1	1, 5, 15, 19	5	Group 1	Rxn 1 or 2	omit	Group 1
2	2, 6, 16, 7	6	Group 1	Rxn 3 or 4	omit	Group 2
3	3, 8, 9, 20	8	Group 1	Rxn 5 or 6	omit	Group 3
4	4, 8,10, 21	8	Group 2	omit	Rxn 1 or 2	Group 4
5	14, 17, 18, 24	17	Group 2	omit	Rxn 3 or 4	Group 2
6						

Team Assignments Experiments 4 - 6 Spring 2008

Team	E 4 Parts 1 and 2	E 4 Part 3 Bromophenol Blue and	E5 Parts 1, 2B, and 3	E6
1	Group 1	Phenolphthalein	Group 1	Rxns
2	Group 2	Phenolphthalein	Group 2	will
3	Group 3	Phenolphthalein	Group 3	be
4	Group 1	Bromothymol blue	Group 4	lab
5	Group 2	Bromothymol blue	Group 1	assigned
6				

GRADING

Spring 2008 Grading breakdown for chemistry 125/126.

TEAM POINTS (54%)	**Maximum achievable points.**
Lab/Team reports (6 total)	187
Discussion presentations (6 total)	83
INDIVIDUAL POINTS (46%)	
Pre-lab report (6 total)	30
Term exam	150
GSI and Peer points	50

COURSE LETTER GRADES vs. POINTS

At least an A- 450 pts.
At least a B- 400 pts.
At least a C- 350 pts.
At least a D- 300 pts. **Point total: 500**

LAB POINT breakdown Spring 2008

Experiment		TEAM REPORT	Discussion	TOTAL
Experiment 1: *Electrons and Solution Color*	**5**	**30**	**10**	**45**
Experiment 2: *Solubility and Water Purity*	**5**	**21**	**14**	**40**
Experiment 3: *Redox*	**5**	**35**	**15**	**55**
Experiment 4: *Acids, Bases, and Salts.*	**5**	**35**	**15**	**55**
Experiment 5: *Lewis acids and bases.*	**5**	**40**	**15**	**60**
Experiment 6: *Analysis of Reactions.*	**5**	**30**	**10**	**45**
			TOTAL =	**300**

Team Report and Discussion points
For further information see the team report grading rubric on the last page of each experiment. For further details on awarding of discussion points see the discussion grading rubricks in the lab manual.

Exam points
There is one term exam (150 points) during spring term. The exam tests your understanding (as opposed to memorization) of the topics and experimental results. Sample exams are posted on the course web site.

SCHEDULE
CHEM 125/126 SPRING 2008

Exp #	Experiment Topics	Laboratory Dates DISCUSSION*	Lab Manual Reading Pages	Points
	Introduction **Check-in** **Safety Scavenger Hunt** **Team Task Exercise**	**4/30**	1-17 214-227	
2	**Solubility and Water Purity** 1. What is the Precipitate? 2. Is Precipitation Predictable? 5A. What's in it?. And (instructor assigned) 3. Water Purity and Concentration Studies or 4. Solvent Pollution and Precipitation.	**5/5** 5/7*	 41-68 174 192-195	40
1	**Electrons and Solution Color** 1. Preparation and Color of salt solutions. 2. Wavelength color. 3. Color and light absorption. 4. Concentration and light absorption. 5. B) What is the sample concentration?	**5/7 &** **5/9** 5/14*	18-40 166-173 175-182	45
3	**Redox: Transferring Electrons** 1. Reactivity of Metals. 2. Reactivity of Halogens & Halides. 3. Analysis of (redox) reactions.	**5/14 &** **5/19** 5/21*	69-97 196-202	55
4	**Acids, Bases and Salts** 1. Structure and Acid-Base Properties. 2. Conjugate acid-base pairs. 3. Neutralization and Indicators. 4.Quantitative Studies of Neutralization. 5. Identification of an Unknown Acid.	**5/21 &** **5/28** 6/2*	98-126 183-188 203-206	55
5	**Lewis acids and bases: Complexation** 1. Acidity of cations and the Periodic Table. 2. Complexation Reactions. 3. Solubility Equilibria and Complexation. 4. Investigations of a Reaction	**6/4 &** **6/9** 6/11*	127-155 207-210	60
6	**Analysis of Reactions**	**6/9** 6/11*	156-165	45
	Checkout (1-3pm)	**6/11**		
	TERM EXAM (noon – 2 pm)	**6/16**		

Detailed Schedule

Chemistry 125/126 Spring 2008

MONDAY	WEDNESDAY
	W–4/30
	noon-1pm (discussion rooms): Complete team assignment info form **1- 2pm (1400 chem)** Lecture: Introduction to the course **2–4 (lab):** Team /lab assignments Check-in Safety Scavenger Hunt Team Task Exercise
M-5/5	**W-5/7**
noon-1 pm (1400 chem.) Pre-lab lecture E2 **≈ 1 – 1:20 pm** Break and complete E2 pre-lab report **≈ 1:15 - 4 pm (E2 lab)** Complete E2 (Parts 1 & 2 and 3 or 4 (as assigned) Complete team report and discussion presentation.	**Noon – 1pm (discussion rooms)** Discussion, E2 **1-2 pm (1400 chem)** Pre-lab lecture E 1 (lab 1 of 2) **≈ 2-2:20 pm** Break and complete E1 pre-lab report **≈ 2:20 - 4 pm (lab):** Conduct E1 (Parts 1, 2, and 3 as time allows)
M-5/12	**W-5/14**
Noon – 1pm (1400 chem): Pre-lab lecture E1 (lab 2 of 2) **≈ 1:15 – 4 pm (lab):** Complete E1 (Parts 4 and 5A) Complete team report and discussion presentation.	**Noon – 1pm (discussion rooms)** Discussion, E1 **1-2 pm (1400 chem):** Pre-lab lecture E3 (lab 1 of 2) **≈ 2 – 2:30 pm :** Break and complete pre-lab report **≈ 2:30 – 4 pm (lab):** Start E3

Chemistry 125/126 Spring 2008 (continued)

M-5/19	**W-5/21**
Noon – 1 pm (1400 chem.) Pre-lab lecture E3 (lab 2 of 2) **≈1 - 4 pm (Lab)** Complete E3 Prepare for discussion Complete team report	**Noon – 1pm (discussion rooms)** Discussion: E3 **1 - 2 pm (1400 chem)** Pre-lab lecture E4 (lab 1 of 2) **≈ 2 – 2:20 pm** Break and complete pre-lab report **≈ 2:20 - 4 pm (lab)** Start E 4
	W-5/28
	Noon – 1pm (1400 chem.) Pre-lab lecture E4 (lab 2 of 2) **1 - 4 pm (Lab)** Complete E 4 Prepare for discussion & complete team report
M-6/2	**W-6/4**
Noon – 1 pm (discussion rooms) Discussion E4 **1 – 2 pm (1400 chem.)** Pre-lab lecture E 5 (lab 1 of 2) **≈ 2 – 2:20 pm** Break and complete pre-lab report **≈ 2:20 – 4 pm (lab)** Start E 5	**Noon – 1 pm (1400 chem.)** Pre-lab lecture E 5 (lab 2 of 2) **≈ 1 – 4 pm (lab)** Complete E 5 Prepare for discussion Complete team report
M-6/9	**W-6/11**
Noon – 1 pm (discussion rooms) Discussion E 5 **1 - 2 pm (1400 chem)** Pre-lab lecture E 6 **≈ 2 – 4 pm (lab)** E6; turn in E6 report at 4 pm	**Noon – 1 pm (discussion rooms)** Discussion E 6. **≈ 1-3 pm (lab):** Checkout and evaluations (peer and course)
M-6/16	
Noon – 2 pm (1400 chem): TERM EXAM	

Chem. 125/126

Preparation for Discussion (Team)

Below is the general format you are expected to follow. You do not have to adhere to it strictly but you should include, at the very least, everything this outline asks for.

Team Abstract of Results (to be handed to your GSI before discussion)

1. Write down the question and problem (s) being addressed in your own words.
2. State what you believe your team has discovered related to the question(s) you're trying to answer. State how the class data (give one example) provides insight into the answer.
3. What do the results mean -- i.e. are there any general implications (such as predictable behavior or properties for untested samples) for your findings?

Team Format for Discussion Presentation of Assigned Question

1. State the question.
2. Mention the most possible solutions that could exist to this problem.
3. Present your team organized class data such that the results/patterns are obvious.
   The class data should be organized and visually represented either on the board or on a Powerpoint slide or on an overhead or a handout. You must, however, avoid holding up class time by writing on the board or preparing handouts or other displays in advance. Your GSI can provide "stock" overhead transparencies of the periodic table for your use.
4. Summarize in a sentence or two your choice of proposed solution or position.
5. Briefly state the reasons you believe your answer is correct, based on the criteria asked for in the question and the relevant class data.
6. Pose the italicized question to the class but be prepared to present the answer.

Team Format for Discussion Presentation of Exam Question

1. State the question.
2. Point out the key experiment data that the question is based upon.
3. Walk through a strategy for solving the question.
4. Answer the question.

Best ways to organize your visual aids: a checklist for discussion.

1. Process your data.
   Never just present an overhead with raw data (photocopy of data output from class)! This is the worst way to show the data. You must re-organize and visualize the data in graphs or in other ways to simplify the amount of information to get your idea across.

2. Use the deductive process to set up your discussion presentation.
   The structure of your presentation will give your viewers clues as to how you went about deducing the problem. Set up your presentation when possible with 1) question, 2)possible answers (be brief), 3) your answer, 4) the reasons for your answer and how the data supports your answer, 5) why your answer is better than the rest, and 6) how your answer can apply to other situations (such as an untested compound).

3. **Follow the general conventions for making overheads.**

   - *Order*: Flow of visual should proceed from top to bottom primarily, left to right secondarily.
   - *Relation.* When points or data are related, color them the same, or surround them with the same shape, or put them in a similar place. Some visual way of linking together abstract concepts that are similar.
   - *Importance*. Your most important points should be in the center of the page, are bolder or thicker or brighter than the less important points, are warm or hot in color tone (orange, red, yellow).
   - *Data Tables and Charting*: Appropriate methods should be selected (see below)

Visualization type (in no particular order)

Tables: They are like small visual Excel spreadsheets. Good for presenting large amounts of data with easily-seen values in each of the cells. Bad for getting your point across quickly.

Line Graphs: These show continuity and direction, but are not very good for showing a collection of discrete points.

Bar Graphs: These are good for large data sets. They are good at displaying a collection of separate values. Should have the y-axis as the number of instances (counts), and the x-axis as the specific data type.

Pie Diagrams (pie charts): if you have 100% of a system, good way to show partial percentages of that 100%. Good and quick, very visually complete and simple, be careful to report what you call 100% when you're making it (i.e., what is the data set size).

Line drawings (drawing by hand or in a drawing program) can be used

Experiment 2 (one session lab of three hours)

A. Student Goals

- **Complete Parts 1 and 2 (all).**

For part 2A:

-Use metal ion solutions assigned for part 2A (table below).

-Do not discard your acetate sheet with ppt. results. You may wish to refer to it and other team results when performing part 2B.

- Enter your team data into CoLABnet and collect the compiled data for part 2A.

For part 2B:

-Record the code as instructed.

- **Complete Part 3 OR 4** (assignment indicated in the table below).

-Enter your team data into CoLABnet for part 3 or part 4 as assigned. Collect the compiled data for both parts 3 and 4 for your future reference.

- **Omit Part 5**

♦ **Prepare abstract and discussion presentation for discussion question.**

♦ **Complete Team Report**

*The team report should include a write-up for part 3 OR 4 as assigned in addition to parts 1 and 2.

B. Team assignments

Team	Reagents Part 2	Reagents Part 3	Reagents Part 4	Discussion Ques.#
1	Group 1	Reaction 1 or 2		3
2	Group 1	Reaction 3 or 4		1
3	Group 1	Reaction 5 or 6		4
4	Group 2		Reaction 1 or 2	5
5	Group 2		Reaction 3 or 4	2
6				

Discussion will occur the first hour of the next session (noon – 1pm)

GSI Announcements

A. Part 2A:

- Proper use of acetate sheets (demo), reagents and pipets (e.g. do not put pipets into reagent bottles, don't allow the tip of a pipet to touch drops on the acetate sheet)
- Organization of a cooperative reagent stand per each lab bench.

B. Part 2B: Assignment of unknown and recording of code.

C. Safety and Waste Disposal:

- Note especially to NOT discard metal ion solutions, acetone or hexane down the sink.
- Separation of aqueous and organic solvents.

D. Next Session: Discussion of experiment 2 will occur in the first hour of your next session.

GSI Demos

Use and disposal of acetate sheet contents. (Part 2A)

Filtration (Part 3). (See also Appendix A3, p.174)

Experiment 1 lab 1 Student Information

A. Team goals (lab 1 of 2)

- **Complete Experiment 1, Parts 1 and 2**

Each student in a team is responsible for preparing one solution.*
Enter the results (solution color) for part 1 into CoLABnet

- **Prepare spectra of team assigned solutions (Part 3)**

Take the spectrum of the team solution assigned for part 4 (table below). If time allows, the spectra of all team solutions should be completed.

- **Prepare set of diluted solutions from assigned solution for calibration curve (Part**

Seal solution tubes or flasks and store in drawer for use next week.

- **Work on answer to team assigned discussion question.**

Turn in informal (several sentences) abstract to instructor before the end of lab regarding questions 1, 2, 3, 4 or by end of 1st hour of 2nd lab regarding question 5, 6.

- **Work on the Team Report as you conduct the lab!**

Note the correction on p. 34 to Part 4. Insert above "Data Analysis", "Procedure and Calibration Graph (attach). Make sure to record the identity of the team sample.

B. Team assignments

	LAB		DISCUSSION question, p.39
Team	**Part 1 Solution***	**Part 4**	
1	1,15,**5**,19	5 (Chromium nitrate)	1
2	#,16,**6**,**7****	6 (cobalt nitrate)	2
3	3,20, **8,9**	8 (copper II nitrate)	3
4	4,21, **8,10**	8 (copper II nitrate)	4
5	14,24,**17,18**	17 (nickel nitrate)	5
6			

* Column 2 (table above) will be GSI adjusted to reflect number of students per team. For example, if team 1 has 3 members (rather than 4), solution #19 or #15, or #1 will be removed. Solution #5 will not be removed from the team assignment since it will be used in Part 4.

****Part I Solutions:**
A706 and A712 #2; A718 = #22

- **E1 Discussion question 4**

Teams addressing question 4 should observe the solutions (p.19, solutions 6 vs.7, 8 vs.9 vs.10, 11 vs.12, 17 vs. 18) made both in water and other reagents (NH_3 or HCl) and obtain copies of the spectra. It may be difficult for a team to answer question 4 based on coLABnet class data alone.

- **Part 4 Solution**

The team assigned solution for Part 4 will also be the identity of the solution of unknown concentration (Part 5B) that teams will analyze in the 2nd meeting of this two session lab.

GSI Demonstrations

- **Use and care of the balance**
- **Solution Preparation: Use of burets for dilutions** (see Appendix A2, pp.168-173)
- **Spectrophotometer calibration**

Experiment 1 lab 2 Student Information

A. Team Goals (lab 2 of 2)

- **Complete Parts 1 – 4.**

Make sure you have taken absorption spectra (Part 3) of all team solutions and attached the spectra to your team report.
Make sure you have entered team data for Parts 1 and 3 into CoLABnet
Make sure to print copies of the collated coLABnet data for data analysis purposes.

- **Complete Part 5B (**We will not do part 5A this term**)**

Record the "unknown code" as instructed and proceed to determine the unknown concentration of your assigned solution of unknown concentration. The solution's identity is the same as that used for Part 4 (under column 3 of the table below).

- **Finish preparation of discussion presentation; Turn in abstract before discussion**

Discussion will occur during the first hour of the next session

- **Complete team report**.

B. Team assignments

	LAB		DISCUSSION question, p.39
Team	**Part 1 Solution***	**Part 4**	
1	1,15,**5**,19	5 (Chromium nitrate)	1
2	#,16,**6**,**7****	6 (cobalt nitrate)	2
3	3,20, **8,9**	8 (copper II nitrate)	3
4	4,21, **8,10**	8 (copper II nitrate)	4
5	14,24,**17,18**	17 (nickel nitrate)	5
6			

C. Student Reminders

- Make sure to read the Team Report Tips on page 30 of the manual.

GSI Announcements

- **Submission of Reports.** Where? When? Late report penalty? (see page 221, lab manual)
- **E1 Discussion and Lab Grading** (Read the information on pp. 37-38 and 40. See also page 219 and page 222 in the manual regarding discussion and grading issues.
- **Turn in discussion abstracts** to GSI if team has not already done so.
- **Safety and Waste Disposal**
- **Entry of Data and Posting of spectra (Part 3)**
- **Assignment of Unknown (Part 5B) and recording of code.**
- **Next week reminder:** Discussion will occur during the first hour**.**

GSI Demos

- Use of the UV-Vis spectrophotometer unless already done

Experiment 3 Student Information (lab 1 of 2)

A. Student Goals (two hour lab following first hour discussion of E2)

Complete Parts 1 and 2A

- Part 1A is performed in pre-lab lecture.
- Use metal and metal ion reagent group assigned for part 1B (table below).
- Enter your team data into CoLABnet for part IB.

Write Team report for E3, Parts 1 and 2A.

Complete Mid-Semester Team Evaluation Form, p.12.

Turn in during lab or to the GSIs atrium mailbox.

Team assignments

	LAB *	DISCUSSION, p.96
Team	**Part 1B**	**Question**
1	Group 1	5
2	Group 2	4
3	Group 3	1
4	Group 4	2
5	Group 2	3
6		

*all teams use identical reagents for parts 2 and 3

GSI Announcements

A. Location and disposal of metals used for testing in part 1B.

B. Part 1B:

- Some reactions occur slowly. Do not conclude "no reaction" unless there is no observable change over a period of time (30 minutes)
- Protective oxide coating on metals must be removed before use.

C. Safety and Waste Disposal

- Do NOT discard metal wires (Part 1B) in the waste bottles or funnels!
- Separate aqueous from organic waste (Part 2A)!
- Do not overflow waste bottles! Inform GSI if a new waste bottle is needed.

GSI Demos

Separation of organic and aqueous waste using separatory funnel.

Removal of oxide coating from metal wires.

Experiment 3 Student Information (lab 2 of 2)

A. Student Goals (3 hour lab)

Complete Parts 2B and 3.

- Enter your team data into CoLABnet for part 2B.

Prepare Team Task Schedule for E4-6 (p. 9, lab manual) unless already done*.

Prepare presentation for E3 discussion.

Complete Team report for E3.

*** GSI will announce any new team arrangements for the 2nd half of the semester.**

B. Team assignments

	LAB *	DISCUSSION, p.96
Team	**Part 1B**	**Question**
1	Group 1	5
2	Group 2	4
3	Group 3	1
4	Group 4	2
5	Group 2	3
6		

*all teams use identical reagents for parts 2 and 3

GSI Announcements

B. Location and safe use of halogen waters (part 2B and 3).

B. Part 2B:

a. Make sure to add sufficient hexane and mix phases thoroughy.

C. Safety and Waste Disposal

- Separate aqueous from organic waste (Parts 2B and 3)!
- Do not overflow waste bottles! Inform instructor if a new bottle is needed.

GSI Demo

Show how to properly mix an aqueous and hexane phase.

Experiment 4 Student Information (lab 1 of 2)

A. Student Goals

Complete Parts 1, 2, and 3

- Enter your team data into CoLABnet for parts IB, 2, and 3.

Complete Team report for E4 thru part 3.

Start preparation of discussion presentation.

C. Team assignments

	LAB		DISCUSSION
Team	**Reagents Part 1& 2**	**Reagents Part 3 Bromophenol Blue and**	**Questions, p.125**
1	Group 1	Phenolphthalein	2
2	Group 2	Phenolphthalein	3
3	Group 3	Phenolphthalein	5
4	Group 1	Bromothymol blue	1
5	Group 2	Bromothymol blue	4
6			

D. Indicators

For information on indicator pH end points refer to p. 183 (lab manual).

GSI Announcements

C. Location of:

pH meters, buffers, indicators, pH paper, magnetic stirrers and stir bars.

B. pH measurements (Parts 1-2)

- Do not dip pH paper into samples; dip stirring rod into sample and then bring rod to paper.
- Calibrate pH meter with two buffers in acid (or base) range.
- Use minimum drops of indicator for titrations; excess drops introduce error since the indicator itself is an acid or base.

C. Safety and Waste Disposal

- **Diluted** acids and bases are drain disposable. (For dilution, add acid to water and not vice versa)
- In the event of body contact with acids or bases, flush the area with water for several minutes and notify GSI.

GSI Demos

Proper use of pH paper
Calibration, care, and use of the pH meter & electrodes. (see also Appendix A5).
Titration skills

Experiment 4 Student Information (lab 2 of 2)

A. Student Goals

Complete E4
Complete team report for E4.
Prepare team discussion presentation (for first hour next session).

B. Team assignments

	LAB		DISCUSSION
Team	**Reagents Part 1& 2**	**Reagents Part 3 Bromophenol Blue and**	**Questions, p.125**
1	Group 1	Phenolphthalein	2
2	Group 2	Phenolphthalein	3
3	Group 3	Phenolphthalein	5
4	Group 1	Bromothymol blue	1
5	Group 2	Bromothymol blue	4
6			

GSI Announcements

A. Location of Practice Samples

Known samples are available for practicing MP and/or or equivalent wt. skills: Acetyl salicylic acid and Azelaic acid. In addition, the oxalic acid dihydrate used in Part 4 can be used to practice taking a melting point.

B. Unknowns (Part 5)

- Record the code # on the vial. Return unused sample & vial to GSI.
- The amount of sample is limited to that in the unknown vial.
- GSI cannot help students perform or interpret results re Part 5.

C. Titration of Unknown

- Standardized 0.10M and 1.0M NaOH is available.
- Indicators available: methyl orange, bromothymol blue, phenolphthalein.
- As base is added, the unknown acid will dissolve. To enhance solubility, stir the mixture with a magnetic stirrer and turn the heat on.

D. Melting Point Determination

- Location of equipment including capillary tubes.
- Do not shove the thermometer into the apparatus.
- Make sure the thermometer is calibrated correctly.
- Don't place hot thermometers on a cool surface or into cold water.
- Record a melting point range (not a point).

GSI Demos

Proper use and filling of melting point capillary tubes.
Melting point determination**.**
Titration set-up.

Experiment 5 Student Information (lab 1 of 2)

A. Student Goals

Complete Parts 1 and 2A

- Enter your team data into CoLABnet for part 1.

Complete Team report for E5 thru part 2A.

E. Team assignments

Team	Cation Group*(p.125)	**Discussion Question, p.154**
1	1	4
2	2	5
3	3	2
4	4	3
5	1	1
6		

- The same cation group reagents are used in Parts 1, 2B, and 3.

GSI Announcements

D. Water (Part 1)

All teams need to use the same water source (of known pH and about pH 7) to test samples (part 1) for the purpose of sharing data.

B. Use of Reagents/Disposable pipets (Parts 1-2A)

- Do not waste pipets! Teams assigned same cation groups can share test tube rack with labeled test tubes containing samples and pipet per sample.
- Do not contaminate reagents. Do not place pipets **into** reagent bottles or pour unused reagent back into a bottle.

C. Safety and Waste Disposal

- Do NOT pour metal ion salt solutions down the drain!
- Dispose beaker/well plate contents in the proper waste container
- Acids and bases are drain disposable if diluted (Acid or base to water).
- Use ammonia (NH_3 or NH_4OH) in the hood!

Experiment 5 Student Information (lab 2 of 2)

A. Student Goals

Complete Parts 2B, 3, and 4.

- Enter your team data into CoLABnet for parts 2B and 3.

Complete Team report for E5

Prepare discussion presentation.

F. Team assignments

Team	Cation Group*(p.125)	**Discussion Question, p.154**
1	1	4
2	2	5
3	3	2
4	4	3
5	1	1
6		

- The same cation group reagents are used in Parts 1, 2B, and 3.

GSI Announcements

A. Use of Reagents/Disposable pipets (Parts 2B and 3)

- Do not waste pipets and avoid contamination! Teams assigned same cation groups can share test tube rack with labeled test tubes containing samples and pipet per sample.
- Do not contaminate reagents. Do not place pipets into reagent bottles or pour unused reagent back into a bottle.

B. Safety and Waste Disposal

- Do NOT pour metal ion salt solutions down the drain!
- Dispose beaker/well plate contents in the proper waste container
- Acids and bases are drain disposable if diluted (Acid or base to water).
- Use ammonia (NH_3 or NH_4OH) in the hood!
- Follow the procedure for part 4 as written. Alterations may result in safety problems.

E6 Student Information

1. Your pre-lab report (p.159) is due at the start of lab.
2. Your team will analyze three reactions during a two-hour lab. Reactions will be announced and assigned when you arrive at lab. There may or may not be one non-reaction among the 3 reactions assigned for analysis.
3. You and your teammates will receive a list of available shelf reagents upon reporting to lab. You will want to refer to this list when choosing reference blank test reagents.
4. On page two is a list of common complex ions for your reference. A *CRC Handbook* will also be available in the laboratory for your reference. On page three are the grading guidelines that will be used to award points for your reaction analysis.
5. Your GSIs role during this experiment is that of Safety Officer and Librarian. Your GSI was told to NOT design experiments or analyze reactions for you.
6. It is recommended that you do not divide the assigned reactions among team members. For maximum understanding and points it is best if this is a collaborative effort. In fact, team members are encouraged to consult with members of different teams!
7. Your written team report for E6 is due at the conclusion of the two-hour lab!
8. You may use the team report forms provided (pp.160-163) or create your own report. If you use the provided forms, one set should be used per reaction (i.e., analysis of only one reaction should be entered on pp. 160-161 and/or one non-reaction pp. 162-163).
9. Make sure to follow the team report guidelines on pp. 156-157 of the lab manual. The guidelines below are a summary of the guidelines provided in the manual. Please also note the grading guidelines for experiment 6 on page 164 of the lab manual.
10. E6 discussion will be held during the first hour of your next session. Your team will orally present your analysis of one of the 3 reactions you analyze in lab. Make a copy of your notes for the reaction to be presented in discussion before turning in your report.

Guidelines for Analysis of Reactions

REACTION

1. **Record qualitative observations of individual reagents and mixture and conclusion** (reaction).
2. **Conduct reference blank tests to identify reacting species.**
   Record all hypothesis, tests, and conclusions.
3. **Identify the product/products.**
   Record all hypothesis; test or compare properties of products with known samples or listing of properties in reference texts (CRC Handbook …).
4. **Record your conclusion.**
   Write the net reaction. Support your net reaction conclusion with experimental tests (e.g. tests of products or confirmation of type of reaction) and/or with data obtained on product properties from reference texts.

NON-REACTION

1. **Record qualitative observations of individual reagents and mixture and conclusion** (no reaction).
2. **Conduct quantitative tests (**a minimum of two that demonstrate no net change in properties of reactants**) and experimental tests that** support the fact that no reaction is occurring**.**
3. **State and support conclusion.**
   Cite data or other information (chemistry or reference text) to support conclusion.

SOME COMMON COMPLEX IONS

Aquo	**Ammine**	**Chloride**	**Hydroxide**
$[Al(HOH)_6]^{3+}$			$[Al(OH)_6]^{3-}$
$[Cd(HOH)_4]^{2+}$	$[Cd(NH_3)_4]^{2+}$		
$[Co(HOH)_6]^{2+}$	$[Co(NH_3)_6]^{2+}$		$[Co(OH)_4]^{2-}$
$[Cu(HOH)_4]^{2+}$	$[Cu(NH_3)_4]^{2+}$	$[Cu(Cl)_4]^{2-}$	$[Cu(OH)_4]^{2-}$
$[Hg(HOH)_4]^{2+}$		$[Hg(Cl)_4]^{2-}$	
$[Ni(HOH)_6]^{2+}$	$[Ni(NH_3)_6]^{2+}$		$[Ni(OH)_4]^{2-}$
$[Pb(HOH)_4]^{2+}$		$[Pb(Cl)_4]^{2-}$	$[Pb(OH)_4]^{2-}$
$[Ag(HOH)_2]^{+}$	$[Ag(NH_3)_2]^{+}$	$[Ag(Cl)_2]^{-}$	
$[Sn(HOH)_4]^{2+}$		$[Sn(Cl)_4]^{2-}$	$[Sn(OH)_4]^{2-}$
$[Zn(HOH)_4]^{2+}$	$[Zn(NH_3)_4]^{2+}$		$[Zn(OH)_4]^{2-}$

Grading Guidelines: E6: Analysis of Reactions

Team Report for three reactions = 30 points possible.

REACTION (TOTAL = 10 points possible)

1. **Record initial qualitative observations (Total = 2)**
   Individual reagents (0 – 0.5pt)
   Mixture (0 – 0.5pt)
   Conclusion (0 –1 pt) (rxn or no rxn).
2. **Conduct reference blank tests to identify reacting species. (Total = 3.5)**
   Hypothesis recorded (0.5 pt)
   Appropriate and sufficient tests conducted (0 – 2 pts)
   Conclusions re reactants (vs. spectators) are correct (0 – 1 pt).
3. **Identify the product/products (Total = 2.5)**
   Hypothesis recorded (0.5 pt)
   Compare/test props of products with known samples and/or listed props. in reference texts (CRC Handbook) (0 – 2 pts)
4. **State conclusion (Total = 2)**
   Write the correct net reaction/s. (0 –1 pt)
   Support the net reaction conclusion by experimental tests (e.g. confirmation of reaction type) or with reference to data obtained. (0 –1 pt)

NON-REACTION (TOTAL = 10 points possible)

1. **Record initial qualitative observations (Total = 2)**
   Individual reagents (0 – 0.5pt)
   Mixture (0 – 0.5pt)
   Conclusion (0 –1 pt) (rxn or no rxn).
2. **Conduct appropriate experiment/s and quantitative tests (Total = 6)**
   Quantitative tests are conducted and appropriate and sufficient (a minimum of two) and are poor (1) or good (2) or very good (2.5) or excellent (0 – 3 points)
   Experiments are performed to confirm no reaction and are poor (1) or good(2) or very good (2.5) or excellent (0 – 3 points)
3. **State and support conclusion (Total = 2)**
   Data or other information (chemistry or reference text) is cited to support a "no reaction" conclusion (0 – 2 points).