**CHEM123L**

**Chemical Reactions Laboratory II**

**Schedule of Experiments**

It is expected that you will have reviewed all relevant sections of the lab manual in preparation for the upcoming experiment before your scheduled laboratory period. You will be performing an experiment on your first day in the laboratory. Arrive prepared!

For your first laboratory period you will need to purchase:

* + Laboratory Manual – Available from the UW bookstore
  + Safety Goggles – EVERYONE must wear them!
  + A Sharpie™ glassware marker – not mandatory, but very useful.

|  |  |  |  |
| --- | --- | --- | --- |
| **Week** | **Sections** | **Ex. #** | **Experiment** |
|  |  |  |  |
| Jan 9 - 13 | 1,3,5,7,9,11 | 1 | Laboratory Check-In **and**  Synthesis of Acetaminophen |
| Jan 16 - 20 | 2,4,6,8,10,12 |
|  |  |  |  |
| Jan 23 - 27 | 1,3,5,7,9,11 | 2 | Spectrophotometric Analysis:  The Breathalyzer© Reaction |
| Jan 30 - Feb 3 | 2,4,6,8,10,12 |
|  |  |  |  |
| Feb 6 - 10 | 1,3,5,7,9,11 | 3 | The Iodide Persulphate Reaction:  The Effect of Concentration on Reaction Rate |
| Feb 13 - 17 | 2,4,6,8,10,12 |
|  |  |  |  |
| Feb 20 - 24 | All |  | **Reading Week - No Labs** |
|  |  |  |  |
| Feb 27 - Mar 3 | 1,3,5,7,9,11 | 4 | pH Chemistry: Acids, Bases and Buffers |
| Mar 6 - Mar 10 | 2,4,6,8,10,12 |
|  |  |  |  |
| Mar 13 - Mar 17 | 1,3,5,7,9,11 | 5 | Electrochemical Cells **and**  Laboratory Check-Out |
| Mar 20 - Mar 24 | 2,4,6,8,10,12 |
|  |  |  |  |
| Mar 28 - 30 | All |  | Pick up marked reports #4 and #5 in STC-4019C |
| TBA | All | Final Exam | Scheduled by the registrar; date, time and location will be announced during the term. |

**Instructor: Sue Stathopulos**

Phone: Ext. 33868

Office: STC-4019C, at the back of the Labs, STC-4019 and STC-4029

Email: [sckramer@sciborg.uwaterloo.ca](mailto:sckramer@sciborg.uwaterloo.ca)

**CHEM 123L Course Outline**

***Course description***

CHEM 123L is closely related to the lecture course, CHEM 123, but is a separate course, graded independently. Experiments are designed to provide hands on experience which will support and enhance the concepts presented in the lecture course. The laboratory explores and expands on course material, reinforcing concepts by allowing students to witness first-hand the chemistry behind the theories learned in lectures.

Five laboratory experiments will be completed during the term in the following areas: 1. Organic Synthesis

2. Spectrophotometric Analysis

3. Reaction Kinetics

4. Acids, Bases and Buffers

5. Electrochemistry

Much of what is learned in CHEM 123L will come from independent study, either in preparation for an experiment or in the writing of the laboratory report. In the lab, students work with a partner, however work that is submitted for grading must be completely original, independent work.

***Expectation of student commitment to the course***

CHEM 123L is a three hour lab held on alternate weeks.

**During the lab:** Each experiment is designed to keep an average student working for two hours. Strong students may find they can finish faster, weak students may take longer. Your time in the laboratory should be used wisely; complete pre-laboratory work before you arrive, focus on the task at hand, divide up the work with your partner, and remember that cleaning up must also be completed before the class ends.

**Outside the lab:** An additional three hours every second week should be expected for lab preparatory work (this includes pre-lab quizzes and assignments), report writing (each experiment will require either an informal or formal report), and post lab review. Formal lab reports can take more than three hours, informal reports should take less, therefore some weeks your work load may be heavier than others.

***Course learning objectives***

Upon completion of this course students can expect to have acquired:

* Hands on experience with theoretical material presented in lectures
* Basic chemistry laboratory skills
* Familiarity with chemistry laboratory protocols, techniques and equipment

***CHEM 123L on Waterloo LEARN***

LEARN is used to highlight changes to the curriculum or other important announcements. This site contains relevant information regarding access to pre-lab quizzes and instructional videos for various lab techniques. Log in at: https://learn.uwaterloo.ca/

***Course Materials***

Required materials: Lab Manual (available at the UW bookstore)

Splash proof safety goggles

Recommended materials: Lab coat

Sharpie or other glassware marker

Course text (for reference when writing reports)

***Contact information***

Instructor: Sue Stathopulos

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Phone: 519-888-4567 ex. 33868

Email: [sckramer@uwaterloo.ca](mailto:sckramer@uwaterloo.ca)

Office hours: I have an open door policy and welcome visits and questions, Monday – Thursday, 9:00 am – 5:20 pm. Unless you have an urgent need, please avoid my busiest times; one-half hour before and after labs start (between 9:00 am – 10:00 am and 2:00 pm – 3:00 pm)

Contact: Feel free to drop in with questions during the hours stated above. Emailed questions are also welcome, however I will only respond during the hours above, so questions sent in the wee hours of the morning before your report is due may not receive a response in time!

TA’s: Your TA will be introduced the first day in the lab. At that time they will also provide their contact information, which you should record in your lab manual.

Your TA may also be contacted using the “Connect” class list feature in LEARN – CHEM 123L, under the TA tab.

***Pre-lab: On-line quizzes – 10% of your final grade***

Before you arrive in the laboratory for experiments 2-5 you will be required to complete a short on-line quiz on the material needed for the experiment you will be performing that day. You will not be expected to answer questions based on the results of the experiment, since you have not performed it yet, however, you will need to know the techniques you will be using, as well as any background information covered in the lab manual.

Quizzes are accessed through the Maple TA web interface:

<http://mapleta.uwaterloo.ca/>

You will have an account created for you in your section of CHEM 123L. User login is your Waterloo UserID, password is your student ID#.

Quizzes access begins 7 days prior, and ends exactly 24 hours prior to your scheduled laboratory period. Access to the weekly quiz will be restricted after this time.

***Pre-lab: procedure summary ~3% of your final grade***

Before commencing work in the lab each student is required to submit an experimental procedure summary to their Teaching Assistant. This summary must be notarized by your TA on the day of your lab, it is later submitted with your lab report and graded as part of the lab report mark for that experiment.

This summary may be written in your choice of format, including point form, flow charts, diagrams, etc. This summary must be written in ink, and contain enough information for you to perform the experiment without your lab manual.

***Laboratory performance mark – 5% of your final grade***

Each day as you work in the lab your TA will be assessing your performance. This assessment is based on your punctuality, preparedness, safe lab practices, work ethic and attitude. A full list of criteria assessed for this mark is available on LEARN – CHEM 123L.

A mark /5 is assigned each day that you work in the lab, and at the end of the term the average of these performance marks will account for 5% of your final grade.

***Information for students with disabilities***

Access Ability Services, located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum.

If you require academic accommodations to lessen the impact of your disability, please register with Access Ability Services at the beginning of each academic term.

***Student assessment***

**How your final grade is calculated:**

5% Laboratory performance mark (see previous page) 10% Weekly pre-lab quizzes (see previous page) 45% Lab Reports (5 in total) 40% Final exam

**Attendance:**

* Mandatory, failure to attend your regularly scheduled lab will result in a deduction of all grades associated with that lab period (typically between 10 – 15% of your final grade). Contact your lab instructor immediately if you miss a lab for any reason.
* Unscheduled absences (Accident or Illness): Absence due to illness must be proven with a Verification of Illness form and are assessed on a case by case basis. If the absence is deemed unavoidable, accommodations a made to complete missed work.
* Scheduled absences (Co-op Interviews, Varsity Team games, Funerals): A lab **may** be rescheduled if a conflict is identified early and warrants special accommodation. Documentation must be presented confirming the reason for your absence.

**Late Penalties:**

* Work submitted after the deadline will receive a grade of 0. Late submissions are not accepted. If you are unable to complete your work by the due date, submission of partially completed work is recommended so that partial marks can be awarded.
* Lab reports are typically due at your next scheduled lab period, allowing two weeks to complete each report. Extensions will not be granted.
* Online quizzes must be completed 24 hours prior to your scheduled lab. Access will be restricted after this time. Failure to complete the online quiz may result in denial of access to the lab, and loss of all grades associated with that day’s work. In the interest of safety, unprepared students can be required to leave the laboratory.

**Data Sheets:**

* Each report must include an original data sheet, written in ink, signed by your TA or Laboratory Instructor. Data sheet not meeting these criteria = report grade of zero.

**Unclaimed work:**

* Term work which has not been claimed by the final day of the exam period for that term will be appropriately discarded.

***Academic Integrity***

**Academic Offences**: When you submit work for grading you are presenting it as your own, original work. Students who submit work that is not original are subject to disciplinary penalties under University of Waterloo Policy 71. All cases of academic misconduct in CHEM 123L are referred to the Associate Dean of the appropriate faculty. A typical penalty for cheating on a course element is a grade of zero assigned to that course element, plus a deduction of 5% of the course grade. The following are considered serious academic offences:

* **Plagiarism**: The words and ideas you submit must be your own. You will use many sources of information during your academic career, but these sources must be properly acknowledged using citations and references in your work. You must learn to present the information you have researched in your own words. If you “cut and paste” directly from your source, the work presented is not yours, but that of the original author. Remember that even ideas that have been paraphrased must be referenced.
* **Copying** from another’s work or allowing someone to copy your work: copied lab reports will receive a mark of zero. Although you work in pairs for the experiment, reports are to be written on an individual basis. No portion of your lab report should be the same as another report. Additionally, if you are found in possession of a lab report from a previous term you will receive a mark of zero for that lab.
* **Fabricating** **data**: as scientists, you all know that this is wrong. There are no penalties assigned for “bad” data, in fact, more is often learned by making some mistakes, recognizing them and explaining their effect on the experiment.

***For information contact:*** *Office for Academic Integrity: uwaterloo.ca/academic-integrity/*

***Academic Integrity:*** *In order to maintain a culture of academic integrity, members of the UW community are expected to promote honesty, trust, fairness, respect and responsibility.*

***Grievance:***  *A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. See Policy #70, Student Petitions and Grievances.* [*http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm*](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm)

***Discipline:*** *A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. For information on categories of offenses and types of penalties, students should refer to Policy #71, Student Discipline,* [*http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm*](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm)

***Appeals:*** *Concerning a decision made under Policy #70 (Student Petitions and Grievances) (other than petitions) or Policy #71 (Student Discipline) a student may appeal the finding, the penalty, or both. A student who believes he/she has a ground for an appeal should refer to Policy #72 (Student Appeals)* [*http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm*](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm)

***Safety in the Chemistry Laboratory***

**Safety Orientation / WHMIS Online Course**

Before you can work in a Chemistry Laboratory at the University of Waterloo, you must have completed the Student Safety Orientation / WHMIS at Waterloo online safety training course accessed via Waterloo LEARN. If you cannot show proof that you have completed this course you may be asked to leave the laboratory.

**Preventing Accidents / Injury**

* Give strict attention to all instructions and ask for clarification if you do not understand. Do not perform unauthorised experiments. Never leave an experiment unattended.
* Keep sinks and bench tops clean. Wipe up all spills and bottle rings immediately. Practice good housekeeping and clean up at the end of the period.
* Aisles and bench-tops must be kept free of obstructions (knapsacks, stools, bags, etc.); all personal belongings must be stored in the cubby holes under the benches.
* Become familiar with the chemicals you will be using before each experiment. Learn the safe handling and disposal requirements. Be aware of the potential for toxic vapour and gases to be produced and work in the fume hoods where indicated. When handling chemicals, keep hands away from the face, eyes and body until you have washed thoroughly.
* Ensure that all equipment is in good working order, and use the appropriate equipment for the task, ex. Hotplates or heating flammable chemicals; face shields and protective clothing where indicated(Check burner tubing, electrical cords, etc.)

**Protecting Yourself against Accidents / Injury**

* Protective clothing:
* Safety Goggles: Splash proof safety goggles are mandatory for the first year chemistry laboratory, this type of goggle gives maximum protection from spills and flying objects.
* Footwear: Shoes must cover the entire foot and have skid-resistant soles.
* Lab Coats: Strongly recommended to protect your skin and clothing.
* Long hair must be secured back while working in the lab
* Food and Drink: Anything you plan to ingest should not be brought into the laboratory. Food or drink brought into the lab will be confiscated.

**Treatment of Injury**

* FIRST AID:

In general, the best First Aid for acid, alkali, or other chemicals splashed on the skin, cuts, abrasions or burns is immediate flushing with large quantities of tap water. Report all accidents and injuries to your instructor or TA as soon as possible in order to ensure proper treatment.

* Chemicals on the skin: If a chemical is splashed or spilled on skin, move to the nearest sink, eyewash or emergency shower and flush the affected area with large quantities of water, inform your instructor, and, if irritation or pain develops, report to Health Services. Locate the emergency shower in your laboratory room.
* Chemicals in the eye: Locate the emergency eye wash nearest to your workstation. If a chemical enters the eye, flowing fresh water should be used immediately to flush out eye for a minimum of 10 minutes. Have someone inform your instructor. After flushing, report immediately to Health Services.
* Cuts, abrasions and burns: For treatment and dressing of cuts and burns, report to your instructor or TA.

**Emergency contact information**

Major injury or illness:

* Fire / Ambulance / Police: Call 911 from any on campus phone

Minor injury or illness:

* Health Services: 519-888-4096 or ex. 84096
* UW Police (non-emergency): 519-888-4911 or ex. 22222

Other health related concerns:

* Poisoning / Overdose Information: 1-800-268-9017
* Telehealth Ontario (24 hour phone access): 1-866-797-0000

***Fire and Explosions***

Fire is one of the major hazards in the chemistry laboratory. For everyone’s safety:

* Learn the location of the nearest fire exit, fire extinguisher, fire alarm pull station and emergency safety shower.
* If the fire alarm sounds, turn off all services (gas, electricity, and water) and leave the building immediately via the exit indicated.
* In the case of a fire or explosion in the lab, evacuate the room and close the doors. Pull the nearest wall alarm and leave the building immediately via the exit indicated. Avoid inhaling smoke and gases resulting from fire or explosion.
* If clothing catches fire, **stop** where you are, **drop** to the floor **and roll** to smother the fire. DO NOT RUN.
* Limit flammable liquids to amount actually needed for immediate use.
* Assemble apparatus so that control valves and switches are accessible if a fire should occur. Do not set up so that it is necessary to reach through the assembly to turn water, gas or electricity on or off.

**Fire Extinguishers**

Fire extinguishers are located in the hallway outside of the chemistry laboratory. These are Multi-purpose Dry Chemical extinguishers (Type ABC) for use on Class A, B and C fires.

* **Class A** fires: ordinary combustible materials (paper, wood, most plastics)
* **Class B** fires: flammable / combustible liquids (gasoline, solvents, grease, oil)
* **Class C** fires: electrical equipment (appliances, wiring, circuit breakers, outlets)

**To operate a fire extinguisher, use the PASS technique:**

**P**ull the pin or locking device.

**A**im low, at the base of the fire.

**S**queeze the handle.

**S**weep slowly and evenly across the base of the fire.

**Only attempt to extinguish a fire if:**

* Everyone is leaving the room and someone is dialing 911.
* The fire is small, not spreading, and the smoke or heat does not pose a threat.
* Your extinguisher matches the type of fire you are attempting to fight.
* You have confidence in fighting the fire, and are familiar the extinguisher.

**Remember: Don’t get trapped by fire. Always keep your back to a clear exit.**

***Safely Handling Chemicals***

Before using a chemical, you should become familiar with the boiling point, flash point, vapour pressure, toxicity, explosive limits, incompatibilities and other special precautions. This information is available to you in the laboratory in the MSDS binders.

Nearly all chemicals are poisonous to the human body to some degree and it is important to use proper caution at all times when handling chemicals.

Vapours create most of the dangers in the laboratory. They may be toxic, flammable or both. Chemicals of these types should be handled in ventilated hoods in such a manner that the vapour will be carried away.

Wash hands frequently when working in the lab. When handling chemicals, keep hands (especially gloved ones) away from your face, eyes and skin until you have washed thoroughly.

Never test chemicals by taste. To sample a gas by odour, fan some toward the nose with the hand after filling lungs with air.

Use a rubber bulb to fill a pipette, do not pipette chemicals or start siphons by mouth.

Pour acids into water slowly, while agitating, never pour water into acid.

Stoppers should be held out of contact with anything but air while pouring from a bottle. If a spill occurs chemicals should be wiped or flushed off a bottle to protect the next user. Re-cap or stopper all chemical containers immediately.

Chemicals are generally expensive. An estimation of the quantity required should be made at the beginning of each experiment. Any excess chemical must **not** be returned to reagent bottles, but disposed of in the appropriate waste container.

Chemicals that react to give off dangerous gases, cause fire or explosion should not be kept in proximity to each other.

Unlabelled chemicals must not be used.

All spills must be cleaned up immediately. For help with chemical clean-up, ask a TA or your instructor. Thoroughly clean and dry lab benches at the end of each lab.

A gas or open flame must never be used to heat flammable liquids. An electric heating mantle, hot plate or steam bath is most desirable.

Neutralize acid or base (clothing, desktop or floor) by washing with plenty of water. Spill kits are available for cleaning up large amounts of acid or base.

Special disposal containers are provided for waste chemicals, all chemicals must be disposed of in these containers, in the waste fume hoods. Nothing goes down the sink drains!

***Safely Handling Glassware***

Laboratory glassware is generally fragile, and many unnecessary and painful accidents have occurred because of improper handling.

* Learn the names of the glassware you will be using in the laboratory so that you can be sure to use the correct item for each procedure.
* Discard chipped or broken glassware into specially marked “Broken Glass” containers.
* Broken glass should be collected with a brush and dustpan or cardboard. Never use a paper towel to clean up broken glass.
* Glassware that is chipped or cracked can break when heated or cooled, often creating a chemical spill or resulting in injury to the experimenter. Inspect beakers and flasks thoroughly for damage before each use.
* Vacuum flasks will collapse violently under vacuum if cracked, chipped or otherwise weakened. Tamping flasks when suction is on full is an unsafe practice. Erlenmeyer and other thin-walled flat bottom flasks are not safe for use under vacuum. Release any vacuum from all parts of apparatus before disconnecting.
* Carry glass tubing and long glassware (burettes, pipettes, thermometers) vertically rather than horizontally.
* Apparatus that can roll such as thermometers, pipettes, etc., should be placed on bench at right angles to the edge to keep them from rolling onto floor.
* All containers should be completely emptied and rinsed before cleaning. Organic residues can react with strong oxidizing agents.
* Pipettes with ragged-edge or shortened ends should be discarded. Syringes or a propipette should be used for toxic or corrosive materials.

***Locker equipment list***

|  |  |  |
| --- | --- | --- |
| 2 beakers, Griffin, 50 mL | 3 flasks, Erlenmeyer, 125 mL | 1 watch glass, 100 mm |
| 2 beakers, Griffin, 100 mL | 3 flasks, Erlenmeyer, 250 mL | 2 stirring rods, glass |
| 2 beakers, Griffin, 250 mL | 1 test tube rack | 2 medicine droppers |
| 1 beaker, Griffin, 400 mL | 12 test Tubes, 20x150 mm | 1 gas lighter |
| 1 beaker, Griffin, 600 mL | 1 graduated cylinder, 10 mL | 1 tweezers |
| 1 beaker, Griffin, 1000 mL | 1 graduated cylinder, 25 mL | 1 test tube brush, small |
| 1 bottle, Boston round, 16 oz. | 1 graduated cylinder, 100 mL | 1 test tube brush, large |
| 1 polyethylene bottle, 1 L | 1 glass funnel | 1 test tube clamp |
| 1 poly wash bottle, 500 mL | 1 plastic burette funnel | 1 crucible tongs |
|  |  | 1 scoopula |

***Locker Check-In procedure – First day in the lab***

Students work with a partner for all experiments in CHEM 123L. Once you have a partner, follow this procedure for the locker check-in:

* Get a pink key requisition slip from the lab instructor. Read, complete and sign the slip.
* Take the key slip to the first year storeroom (between the two labs) to get your locker key. This key opens both the top and bottom locker drawer.
* Open your locker drawers. Check the equipment inside against the locker equipment list on the previous page. Anything missing or broken can be replaced at the storeroom; today is your only chance to replace equipment free of charge, check everything carefully!
* After today this equipment is your responsibility; no one else uses your equipment. You and your partner are the only people who have keys for your locker. At the end of the term you will have to pay to replace any missing or broken equipment.
* Remember to lock both drawers of your locker after each lab period.

***Locker Check-Out procedure – Last day in the lab***

The last day in the lab will include a locker check-out; this is the day students are expected to pay for missing or broken equipment. Follow these instructions to complete your locker check-out.

* Take everything out of the drawer and clean the drawer and equipment if necessary.
* Check the equipment list, make sure everything is present and in good working order. Replace missing or damaged equipment by purchasing it from the storeroom.
* **Do not** return the equipment to your drawer.
* Have your Teaching Assistant check your equipment and collect your locker key. If everything is accounted for, your TA will give you a signed check-out slip indicating that your locker equipment is complete.
* Take this slip to the storeroom and exchange it for the pink key requisition slip you filled in on the day of check-in.