COLLEGE OF SCIENCE, TECHNOLOGY & APPLIED ARTS

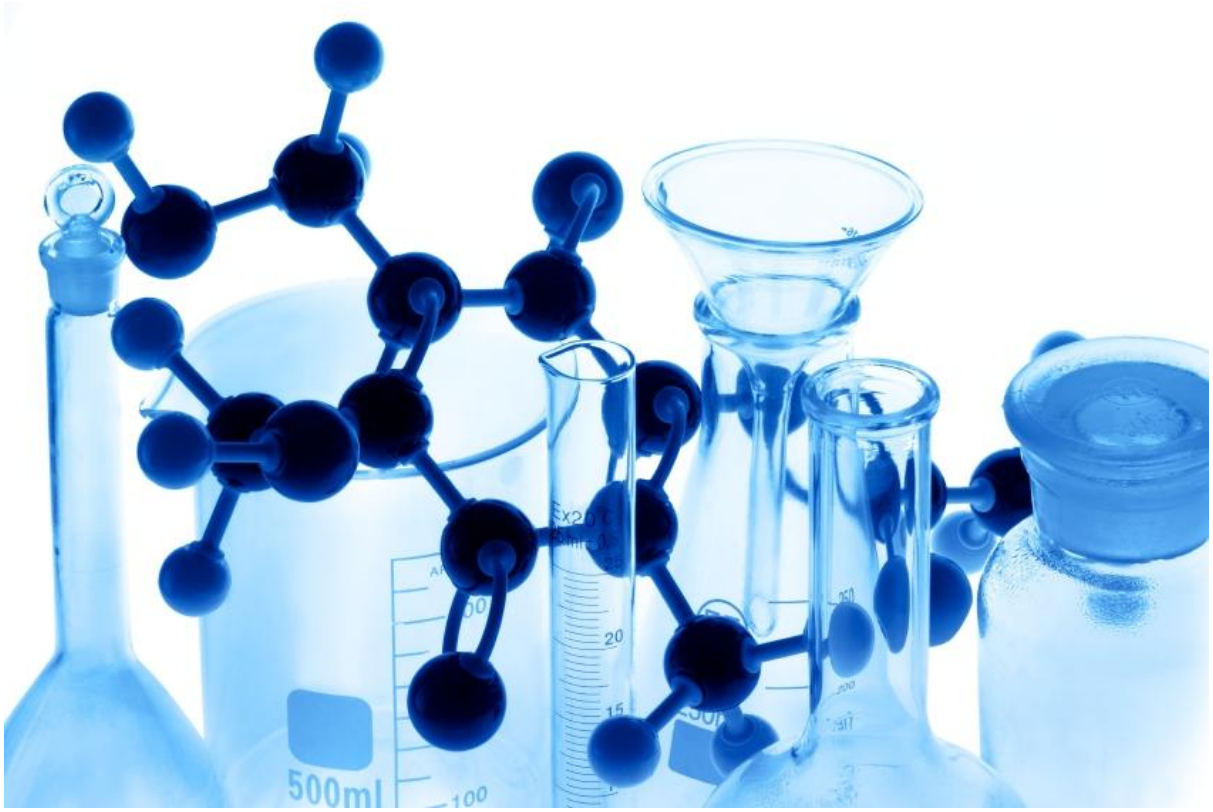
OF TRINIDAD & TOBAGO

School of Nursing Health and Environmental Sciences
Department of Natural & Life Sciences

CHEM 092 – Introduction to Concepts in Chemistry II

Student Manual

Edited: 29/02/2016



A Word of Welcome

The School of Nursing Health and Environmental Sciences and the Department of Natural & Life Sciences welcome you to the practical component of the course. The experiments that form part of this course have been selected to:

- Reinforce your knowledge and understanding of the theoretical content of your first year Chemistry course.
- Develop skills such as observing, recording, measuring and reporting of results.
- Teach you special techniques, such as weighing, pipetting, titrating, filtration etc, so that you will become familiar with the basics of laboratory work.

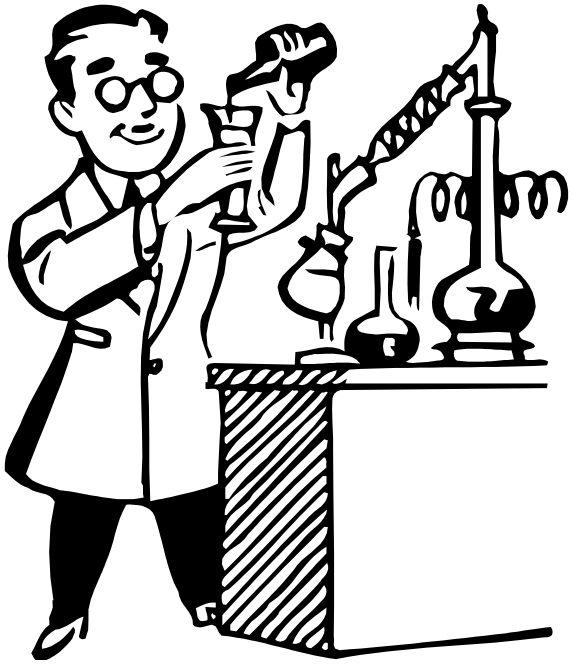


TABLE OF CONTENTS

Introduction

General

Always read and study the relevant experiment before coming to the laboratory. Check out appropriate references to help you understand the procedures you will be carrying out.

Attendance at all laboratory sessions is compulsory.

Learning lab techniques must come from *experiencing* lab techniques. Experience is gained from carrying out experiments. You will need to plan ahead for your lab session, and think about what you are doing (and why) while you are in lab.

Use past experiences to develop new skills.

You will gain new skills with new equipment and learn more about the chemistry theories and concepts you hear about in lectures, but the skills that we expect you to develop the most during these experiments are general scientific skills that should be transferable to any other scientific discipline and to your daily life. These skills developed in the laboratory are fundamental to the world of work because industries depend on the laboratory to maintain a level of quality, which enhances the company's reputation, as well as for product development.

The lab is a part of the learning process.

LABORATORY SCHEDULE:

The Lab schedules are posted at the start of the semester on notice boards, lab tech stations and on the lab doors. Please refer to them to find out the dates and times of your lab sessions.

Once the semester begins, you will have to balance your laboratory study time with all of the other demands that you have. Most of the experiments have been scheduled so that the average student can finish everything (including the report) required in the laboratory period.

You are expected to attend all scheduled laboratory periods and make-up labs will not be scheduled.

SONHES Multi-Science Laboratory Rules

Before Entering the Lab

Proper attire is required for entry into the lab*

- Lab Coat
  - Long sleeve (wrist length)
  - Knee Length
  - Drill cotton
- Long pants or long skirt (ankle length)
- Shoes that fully cover your feet
- Long hair tied back
- No dangling jewelry or accessories

Punctuality

- Students are not allowed entry into lab 15 minutes ***after*** the start of the lab session.

During the Lab Session

- No eating, No drinking, No chewing of gum, No smoking
- Mobile phones and electronic devices (laptops, tablets etc.) are not to be used in the lab.
- Students are expected to follow the lab rules and to follow the guidance of the lab technicians while in the lab.
- Students are expected to have their own lab manuals at each lab session. No new manuals will be issued to students who forgot to bring theirs.

Leaving the Lab

- Students are required to wash all glassware, return items to student cupboards as well as dispose of gloves, tissue, scrap paper etc and wipe countertops before leaving the lab.
- Lab coats are to be taken off when leaving the lab (including trips to the bathroom).

*LAB LECTURERS OR LAB TECHNICIANS MAY PREVENT ENTRY OR ASK STUDENTS TO LEAVE THE LAB IN THE EVENT OF STUDENT NON-COMPLIANCE TO THE LABORATORY RULES.


Wrist length sleeves for coverage
Protects clothes
Able to button at front
Thick material for protection from spills
Durable, long lasting protection for future labs
Feel like a scientist!!

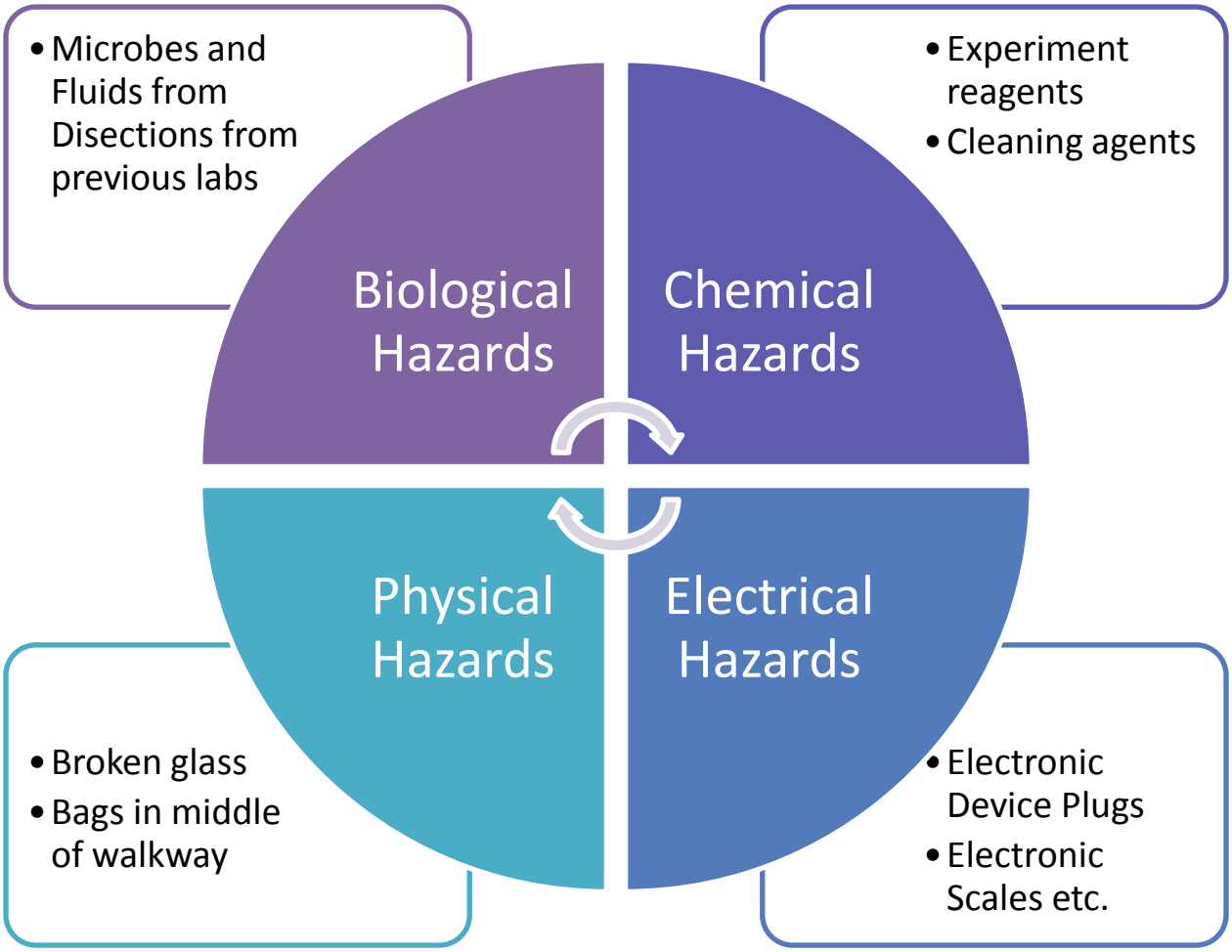

Minimal barrier against chemicals and microbes
Skin exposed
Thin material allows chemicals to permeate and reach skin
Hoodies can transmit contaminants to friends & family


Feet fully covered!
Comfortable
Ankle length Pants
Protection from spills and broken glassware


Feet exposed
Limited protection from spills
Possiblity of cuts from broken glassware
Possible exposure to pathogens

SAFETY IN THE CHEMISTRY LABORATORY

The laboratory is a hazardous environment in which to work. The hazards are often unavoidable since scientists regularly have to use hazardous materials and equipment. However, with sensible precautions the laboratory is probably no more dangerous than your home. You MUST AT ALL TIMES OBSERVE ALL RULES stated in this manual.



Proper Lab wear

Gloves, lab coat, proper lab shoes

Barrier to prevent contact of contaminants with skin

Be Punctual

Check the schedule regularly, arrive to lab on time

Be present for all safety information regarding the lab

Good Hygiene

Wash hands when leaving the lab, swab counter tops after lab

Prevents cross contamination to surfaces outside of lab

Proper use of Equipment

Check electric cords before use

Always use equipment for its intended purpose

Essential Rules for Laboratory Safety

The essential rules for laboratory safety can be expressed under two simple headings:

ALWAYS AND NEVER

ALWAYS

- Familiarize yourself with the laboratory safety procedures.
- Dress appropriately.
- Wash your hands before leaving the laboratory.
- Read the instructions for the laboratory protocol **carefully** before starting any experiment.
- Handle all chemicals with great care.
- Keep your working area tidy.
- Immediately inform your instructor about spills.

NEVER

- Eat or drink in the laboratory. CHEWING OF GUM IS STRICTLY PROHIBITED!
- Smoke in the laboratory
- Inhale, taste or sniff chemicals.
- Fool around or distract neighbours.
- Carry out unauthorized experiments.

Laboratory Safety Procedures

Your laboratory will have certain procedures, which you must be familiar with. Make sure you know where all the exits from the laboratory are, in the event of an evacuation because of fire or other incident. Locate the SHOWERS and eyewash stations and know the type the fire extinguishers that are in the laboratory and how to operate them.

Dress Code

- Wear a Lab coat.
- Wear shoes that cover your entire feet (sneakers) Avoid open footwear & high heels. So sandals, slipper and ballet flats are unacceptable.
- Wear approved safety goggles or safety glasses when in the lab.
- Avoid floppy garments; avoid things that dangle. These get tangled up in equipment or glassware and cause accidents.
- Avoid long, loose hair styles for the same reason. When Bunsen burners are in use, long hair sometimes catches on fire.

Laboratory Techniques

Handling of Acids or Bases

- In addition to the dress code above, personal protective equipment, such as Vinyl" gloves or "nitrile" GLOVES SHOULD be worn.
- For even more dangerous liquids, thick "nitrile" gloves should be used. These are very safe.
- **DO NOT add *WATER* to *CONCENTRATED ACID*.** The heat generated will cause splattering. If necessary to prepare certain solutions, **DO** add ACID to WATER (instead of the reverse order of addition). The heat generated will be less, but splattering still may occur. A good practice in all lab operations is to keep things at arm's length.

Become acquainted with handling laboratory safety equipment e.g.

- Fire Extinguishers
- Fire Blanket
- Eye-wash Fountain
- First-Aid Kit

Become acquainted with using of the FUME HOOD

- Use the HOOD for reactions that give off vapours, especially smelly vapours.
- The draft of the HOOD will sweep away vapours so that the lab itself maintains reasonable air quality.

Locate the Safety Shower and understand how it works

- Shower should be used for ***dire EMERGENCY*** only!
- If you are ***ON FIRE***, or suffer a ***massive spill*** of a **dangerous chemical**, and need to get it off rapidly.

Position yourself under the safety shower and pull the handle—a deluge of water will result.

Immediately clean up Broken Glass

- Sweep it up right away
- Place the broken glass in a "SHARP'S CONTAINER.
- This is a thick walled carton that will be sealed and discarded as such.

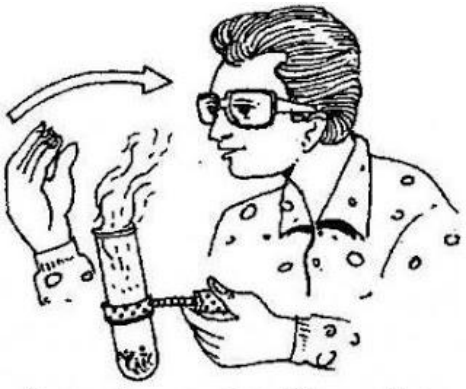
Student Use of the Laboratory

- No UNAUTHORIZED experiments! These are terrible dangers in unskilled hands
- No EATING or DRINKING in the LAB. A good practice is to assume everything in the lab is toxic.
- DO NOT drink from lab equipment. NOT EVEN distilled water.
- When using pipettes, **DO NOT** suck the liquid into the pipette directly by mouth.
- Frequent mistakes, even by skilled lab workers, lead to the liquid reaching the mouth.
- Do NOT smell the flask directly.

Housekeeping:

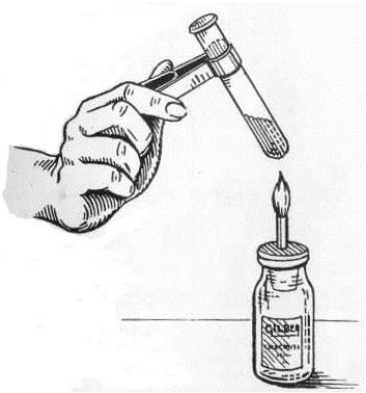
- **STUDENTS MUST CLEAN UP AFTER THEMSELVES**.
- Paper and trash must not be left in the room, thrown into drawers, sinks, on the floor, etc.
- When the equipment boxes are on carts, students who take a box form the cart to do an experiment must put everything back into the box neatly and put the box back on the cart.

If you absolutely must test the odour, carefully waft the vapour from the flask toward your nose with your hand, keeping the flask quite distant from your face.



Correct way of wafting odors.

Make sure that reaction tubes, e.g. test tubes, are not directed toward yourself or other persons. The chemicals may splatter out the tube.



WASTE DISPOSAL

We all have a responsibility towards a clean and safe environment. The Chemistry Department's policy dealing with the disposal of laboratory waste is in accordance with the Occupational Health and Safety Act, which is a law of our country. We do not expect you to understand every aspect of this law, but as responsible citizen and laboratory user you must be aware of the correct procedures for disposal of the different classes of laboratory waste. You will be given specific instructions on how to dispose of your chemical wastes during each pre-lab briefing. Here are also some general rules that you must take note of:

1. Place broken glass into the specially marked bins.
2. Drain all harmless chemicals in solution into the sink followed by plenty of running water.
3. Pour toxic inorganic waste solutions into the specially labelled container in the fume cupboard.
4. Discard paper and any other solid waste into the bin.
5. Ensure that matches are extinguished before disposing of them in this way.
6. Shut off all gas and water lines when not in use.

MANAGING YOUR TIME DURING THE PRACTICAL

1. It is recommended that you arrange your workbench according to the diagram below. Keeping your workspace organized and free of clutter will save you time and frustration, and contributes greatly to laboratory safety.

	BENCH SOLUTIONS	
USED APPARATUS AND DIRTY GLASSWARE		SOLUTIONS AND DRY CHEMICALS
PAPERWORK (PRAC MANUAL, REPORT SHEET AND FLOW DIAGRAM)	EXPERIMENTAL SET-UP	CLEAN GLASSWARE

2. When collecting chemicals:

   - Choose the size of your container according to the volume of chemical that you will be collecting, for instance: for 100 cm^3 of solution, use a 250 cm^3 beaker and for 10 cm^3 use a test tube.

   - Before collecting chemicals and/or solutions from the dispensary, mark each container with the name or formula of the chemical to be collected. This will prevent any mix-ups later on.

3. Use a small notebook for jotting down masses, measurements and observations. Writing these bits of information on slips of scrap paper that can easily be lost is not only unprofessional, but also risky because it means that your whole afternoon's practical work can be wasted because of lost data.

GETTING STARTED

For each laboratory period, including the first, you will be required to:

- Study the entire experimental outline in the **Laboratory Manual**. It includes specific directions concerning laboratory philosophy and protocols.
- Prepare your **Laboratory Notebook**. Include a summary and a procedural outline for your experiment (see "Rules for Keeping Your Laboratory Notebook" and Instruction in the experiment outline).
- Bring your safety goggles or use the safety goggles provided. These offer adequate protection against accidental splashing of corrosive chemicals.
- Come to lab dressed appropriately

A GOOD PRACTICE:

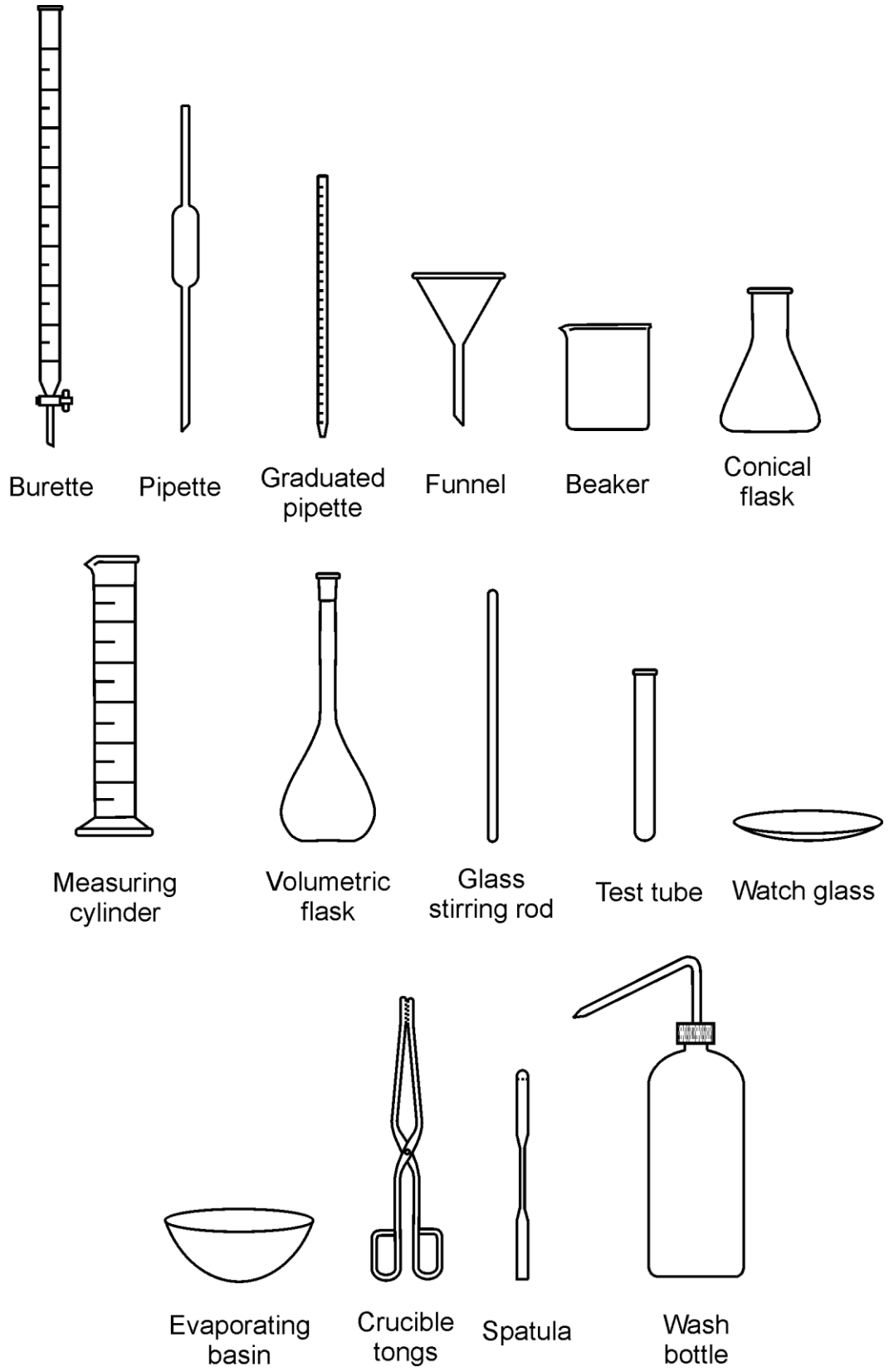
Read the experimental procedure ahead of lab.

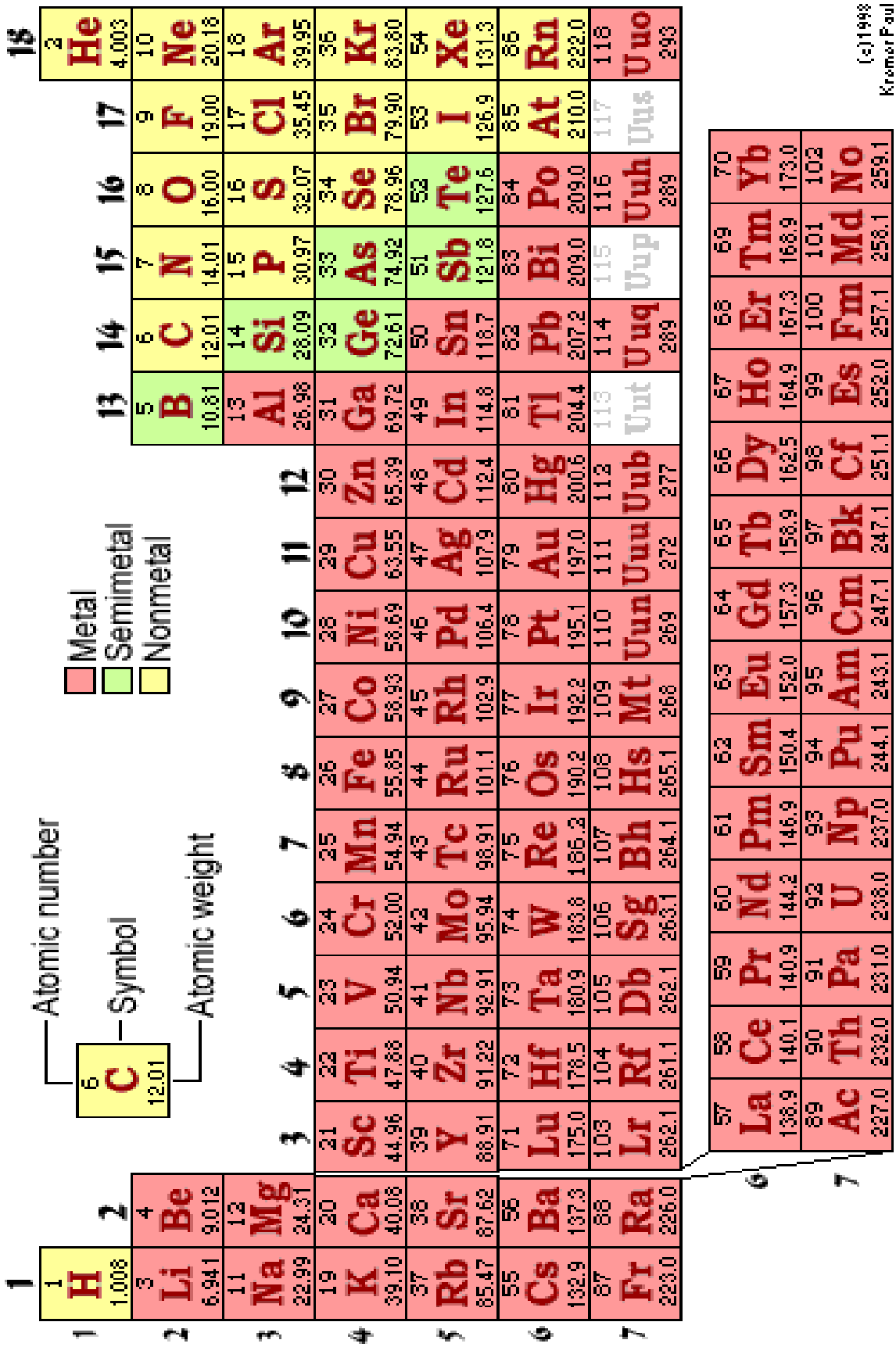
Avoid horseplay. In a laboratory setting, horseplay, even if good-natured, is absolutely unacceptable.

- **No pushing!**
- **No shoving!**

At the end of the lab period: Exit the lab in an orderly manner. Again: no running, no pushing, AND NO shoving.

Figure 1: Apparatus that you will be using in the laboratory




Atomic number
Symbol
Atomic weight
Metal
Semimetal
Nonmetal
(c)1998 Kramer Paul

Lab 1: TITRATION METHOD

AIM:

To Titrate Sodium Hydroxide with Hydrochloric acid

APPARATUS:

Burette ($50cm^3$), pipette ($10cm^3$), three conical flasks ($250cm^3$), two beakers ($250cm^3$), funnel, wash bottle, retort stand, boss and clamp, pipette filler.

MATERIALS:

0.1 mol dm^{-3} hydrochloric acid, 0.1 mol dm^{-3} sodium hydroxide, phenolphthalein indicator

PROCEDURE:

1) Rinse the burette twice with a little hydrochloric acid and fill up to just above the zero mark.
2) Run out acid to remove any air trapped in the jet and refill to above the zero mark.
3) Open the tap of the burette and allow acid to run out until the bottom of the meniscus is just on the zero mark when viewed at eye level.
4) Remove any hanging drop from the jet by touching against the inside of the beaker containing the acid.
5) Draw up sodium hydroxide solution using the pipette to above the graduation mark and allow the solution to run into the sink. This is the rinsing of the pipette.
6) Draw up sodium hydroxide solution using the pipette to above the graduation mark and allow the meniscus to fall until the bottom of the meniscus is resting on the graduation mark when viewed at eye level.
7) Run the sodium hydroxide solution from the pipette into a conical flask. After all the liquid has run out from the pipette touch the tip of the pipette against the bottom of the flask and withdraw after 15 sec.
8) Repeat steps 6 and 7 using the other conical flask.
9) Place two drops of phenolphthalein indicator into each flask.
10) Perform titrations on the contents of each flask against the acid from the burette.
11) Record your results in a table and use this to find the end-point of the titration.

Burette Readings

	Rough	Accurate		
		1	2	3
Final burette reading /cm^3				
Initial burette reading/cm^3				
Volume used/cm^3				

TREATMENT OF RESULTS:

1) Write a balanced equation for the reaction in this experiment
2) Calculate the mean titre volume
3) Calculate the number of moles of HCl in the volume used in the titration using your mean titre volume.
4) Using your answer to 3 and the mole ratio of the equation, calculate the number of moles of NaOH in the 10.0 cm^3 pipette.
5) Calculate the number of moles of NaOH present in 1dm^3 of solution (concentration in $moldm^{-3}$). How close is it to 0.1M?
6) Calculate the concentration of NaOH in gdm^{-3}

Lab 2: Determination of Concentration of an Unknown Solution by Titration Method

AIM:

To determine the concentration of an unknown solution of sodium hydroxide

APPARATUS:

Burette ($50cm^3$), pipette ($10cm^3$), three conical flasks ($250cm^3$), three beakers ($250cm^3$), funnel, wash bottle, retort stand, boss and clamp, pipette filler.

MATERIALS:

0.1 mol dm^{-3} hydrochloric acid, unknown sodium hydroxide solution, phenolphthalein indicator

PROCEDURE:

1) Rinse the burette twice with a little hydrochloric acid and fill up to just above the zero mark.
2) Run out acid to remove any air trapped in the jet and refill to above the zero mark.
3) Open the tap of the burette and allow acid to run out until the bottom of the meniscus is just on the zero mark when viewed at eye level.
4) Remove any hanging drop from the jet by touching against the inside of the beaker containing the acid.
5) Draw up sodium hydroxide solution using the pipette to above the graduation mark and allow the solution to run into the waste beaker. This is the rinsing of the pipette.
6) Draw up sodium hydroxide solution using the pipette to above the graduation mark and allow the meniscus to fall until the bottom of the meniscus is resting on the graduation mark when viewed at eye level.
7) Run the sodium hydroxide solution from the pipette into a conical flask. After all the liquid has run out from the pipette touch the tip of the pipette against the bottom of the flask and withdraw after 15 sec.
8) Repeat steps 6 and 7 using the other conical flask.
9) Place two drops of phenolphthalein indicator into each flask.
10) Perform titrations on each flask against the acid from the burette.
11) Record your results in a table and use this to find the end-point of the titration.

Burette Readings

	Rough	Accurate		
		1	2	3
Final burette reading /cm^3				
Initial burette reading/cm^3				
Volume used/cm^3				

TREATMENT OF RESULTS:

1) Write a balanced equation for the reaction in this experiment
2) Calculate the mean titre volume
3) Calculate the number of moles of HCl in the volume used in the titration using your mean titre volume.
4) Using your answer to 3 and the mole ratio of the equation, calculate the number of moles of NaOH in the 10.0 cm^3 pipette.
5) Calculate the number of moles of NaOH present in 1dm^3 of solution (concentration in $moldm^{-3}$)
6) Calculate the concentration of NaOH in gdm^{-3}

Lab 3: Redox Titration

AIM

To Determine the Number of Molecules of Water of Crystallization in ammonium iron (II) sulphate crystals

APPARATUS

Burette ($50cm^3$), pipette ($25cm^3$), three conical flasks ($250cm^3$), two Beakers ($250cm^3$), funnel, wash bottle, retort stand, boss and clamp, pipette filler.

MATERIAL

0.020 mol dm^{-3} potassium manganate(VII) solution, 39.2 g dm^{-3} ammonium iron(II) sulphate, 1 mol dm^{-3} sulphuric acid.

THEORY

Ammonium iron (II) sulphate is a double salt with the formula $(NH_4)_2Fe\ (SO_4)_2.nH_2O$, where n is the number of molecules of water of crystallization. Hence the properties of its solution will be those of its component ions. One of these ions is Fe^{2+} and this is the actual reducing agent. The potassium manganate (VII) is the oxidizing agent. The reaction between the MnO_4^- ion of potassium manganate (VII) and Fe^{2+} of the ammonium iron (II) sulphate is given by the redox equation:

$$MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \longrightarrow Mn^2+(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$$

From this equation it can be seen that 1 mol of MnO_4^- reacts with 5 mol of Fe^{2+}. Using this equation and the results of the titration, the concentration of the Fe^{2+} ions can be determined. From this result, and the information provided, the number of molecules of water of crystallization in the double salt can also be calculated.

PROCEDURE:

1) Rinse the burette twice with a little potassium manganate (VII) solution and fill above the zero mark.
2) Run out potassium manganate (VII) to remove any air trapped in the jet and refill to above the zero mark.
3) Open the tap of the burette and allow potassium manganate (VII) to run out until the top of the meniscus is just on the zero mark when viewed at eye level. - With manganate (VII) titrations you read the top of the meniscus since the bottom of the meniscus is not clearly visible.
4) Remove any hanging drop from the jet by touching against the inside of the beaker containing the potassium manganate (VII).
5) Draw up the ammonium iron (II) sulphate solution using the pipette to above the graduation mark and allow the solution to run into the waste beaker. This is the rinsing of the pipette.

6) Draw up the ammonium iron (II) sulphate solution using the pipette to above the graduation mark and allow the meniscus to fall until the bottom of the meniscus is resting on the graduation mark when viewed at eye level.
7) Run the ammonium iron (II) sulphate solution from the pipette into a conical flask. After all the liquid has run out from the pipette touch the tip of the pipette against the bottom of the flask and withdraw after 15 sec.
8) Repeat steps 6 and 7 using the other conical flasks.
9) Perform titrations on the contents of each flask against the potassium manganate (VII) from the burette until the first permanent trace of pink is obtained.
10) Record your results in a table and repeat the titration until you obtain consistent results.

RESULTS:

Burette

	Rough	Accurate		
		1	2	3
Final burette reading /cm^3				
Initial burette reading/cm^3				
Volume used/cm^3				

TREATMENT OF RESULTS:

1) Calculate the number of moles of MnO_4^- in the volume used in the titration using your mean titre volume.
2) Using your answer to 1 and the mole ratio of the equation, calculate the number of moles of Fe^{2+} in the 25.0 cm^3 pipette.
3) Use your answer to 2 to calculate the concentration of Fe^{2+} in mol dm^{-3}.
4) Divide 39.2 g dm^{-3} by your answer to 3 to get the relative molecular mass of the double salt.
5) 284 + 18n = answer from 4. Use this to calculate n.
6) Your answer for n to the nearest whole number is the number of molecules of water of crystallization in ammonium iron (II) sulphate.

APPENDIX A

LAB REPORT SHEET FORMAT

NAME:

PARTNER(S) NAME:

DATE:

TITLE:

AIM: brief description of the purpose of the lab.

APPARATUS: list of all the equipment and chemicals that were used in the exercise.

METHOD: written in past perfect tense, this is a numbered sequence of the steps that were followed to carry out the exercise.

For example: The addition of iodine to a test tube would be described in the following way:

"The iodine **was added** to the test tube…"

NOT

"They added iodine to the test tube…"

PRECAUTIONS FOR ACCURATE RESULTS AND SAFETY:

- List of two important precautions which must be followed when using the equipment for the lab exercise.
- For the procedure followed in the virtual lab, suggest two safety measures which must have been observed.

RESULTS: present the results of the experiment (the things you saw or heard). Draw a table wherever possible (title should be written in caps and underlined **above** the table).

CONCLUSION: in relation to the aim of the experiment, the deductions made based on the results obtained.

ANSWERS TO QUESTIONS: answer any post lab questions.

APPENDIX B

EXAMPLE OF A COMPLETED LAB REPORT SHEET

NAME: Jane Joelly

PARTNER'S NAME: Richard Rally

DATE: 20.05.2016

TITLE: Osmosis

AIM: To observe the process of osmosis.

APPARATUS: 3 cups, vinegar, corn syrup, water, egg, stop-clock.

METHOD:

1. The egg was soaked in vinegar for two days.
2. The egg shell was then removed leaving the soft membrane still holding the yolk and albumen.
3. The egg was then placed in a cup containing enough corn syrup to cover most of it and left for an hour.
4. Any difference in size and appearance was recorded.
5. The egg was then placed in another cup containing just enough fresh water to cover most of it for another two hours.
6. Any difference in size and appearance was recorded.

PRECAUTIONS FOR ACCURATE RESULTS AND SAFETY:

Accuracy:

- The stop clock was tested before use to ensure that it was working properly.
- The batteries in the stopclock were changed to ensure that they did not run out during the experiment.

Safety:

- Gloves should have been worn to protect the hands from vinegar.
- Protective glasses were worn to protect the eyes form the vinegar.

RESULTS:

After I hour in the corn syrup, the egg was smaller than it was at first. There were also wrinkles on the surface.

After 10 minutes in the fresh water, the wrinkles disappeared. The longer the egg stayed in the fresh water, the larger it swelled.

CONCLUSION:

In this experiment, osmosis was observed. Osmosis is the movement of water particles from a dilute solution to a more concentrated solution across a semi-permeable membrane. When the egg shell was removed, the membrane left behind was semi-permeable. The albumen was more dilute than the corn syrup, so water moved from the albumen across the semi-permeable membrane and into the syrup. This caused the egg to reduce in size and wrinkle. The albumen was more concentrated than the fresh water however, so water particles moved across the semi-permeable membrane into the egg, making it swell.

ANSWERS TO QUESTIONS:

1. Would the same observations be made with an egg with the shell intact?

   No, because the egg shell is not semi-permeable.

2. If the experiment is carried out using the same method but replacing the corn syrup with salt water what observations would be made?

   The same observations would be made once the concentration of the salt solution was higher than that of the albumen.

APPENDIX C

LAB RUBRIC

This is the Mark Scheme which will be used to score your Lab Reports

SECTION	COMPETENCY	PERFORMANCE RATING			
		Excellent **4**	**Average** **3**	**Fair** **2**	**Poor** **1**
Aim	Effective Communication	The aim is clearly stated.	The aim is slightly unclear.	The aim is quite vague.	The aim is not stated.
Apparatus	Knowledge	Apparatus list is complete. Student gives the correct name of all equipment used.	Apparatus list is complete. Student gives the correct name of most equipment used.	Apparatus list is incomplete. Student gives the correct name of most the equipment they listed.	Apparatus list is incomplete. Student gives the correct name of only a few pieces of the equipment they listed.
Method	Effective Communication	Method is correct, logical, complete and written in appropriate tense.	Method is incorrect, or illogical, or incomplete or written in inappropriate tense.	Method has two - three deficiencies.	Method is incorrect and illogical and incomplete and written in inappropriate tense.
	Technical expertise	Students suggest at least two precautions and two safety measures for each lab which are relevant and accurate.	Students suggest at least one precaution and one safety measure for each lab is relevant and accurate.	Students suggest at least one precaution or one safety measure for each lab which is relevant and accurate.	Students do not suggest any precaution or safety measure which is relevant and accurate.

Results	Effective Communication	Each observation is accurately and completely included.	Most observations are accurately and completely included.	Few observations are accurately and completely included.	No observations are accurately and completely included.
	Technological Expertise	All results are recorded in appropriate format. All calculations, tables and graphs are done correctly.	Most results are recorded in appropriate format or most calculations, tables and graphs are done correctly.	Most results are not recorded in appropriate format or most calculations, tables and graphs are not done correctly.	Most results are not recorded in appropriate format and most calculations, tables and graphs are not done correctly.
Conclusion	Analytical Ability	The chemical principles underlying each observation are fully explained and relevant conclusions are made.	The chemical principles underlying most observations are fully explained and relevant conclusions are made.	The chemical principles underlying few observations are fully explained and relevant conclusions are made.	No observations are fully explained and irrelevant conclusions are made.
Post lab questions/ Post Lab Worksheet	Analytical Ability	All questions answered correctly.	Most questions answered correctly.	Few questions answered correctly.	No questions answered correctly.

APPENDIX D

LAB ASSESSMENT SHEET

The marks for each lab you submit will be recorded on one of these sheets by the Lab Lecturer.

i. Student Name:	
ii. Course:	
iii. CRN:	
iv. Lab #:	
v. Date:	

Section	**Competency**	**SCORE**				**COMMENTS**
Aim	Eff. Comm. 1	**4**	**3**	**2**	**1**	
	TOTAL					
Apparatus	Knowledge	**4**	**3**	**2**	**1**	
	TOTAL					
Method	Eff. Comm.	**4**	**3**	**2**	**1**	
	Tech. Exp.	**4**	**3**	**2**	**1**	
	TOTAL					
Results	Tech. Exp.	**4**	**3**	**2**	**1**	
	Eff. Comm.	**4**	**3**	**2**	**1**	
	TOTAL					
Conclusion	Analytical Ability	**4**	**3**	**2**	**1**	
	TOTAL					
Post Lab questions	Analytical Ability	**4**	**3**	**2**	**1**	
	TOTAL					
TOTAL LAB MARK /32:						
TOTAL LAB MARK (%):						
LAB LECTURER:						