Introduction to the Formal Laboratory Report
Chemistry 12
Titration Lab Guidelines

Explanation:
Lab reports are the most important kind of document written by students in science and engineering programs at the university level. Regardless of the experiment performed, the goal of a lab reports is always the same: to document your findings and communicate what it means.

A good lab report does more than present data; it demonstrates the writer's understanding of the concepts behind the experiment. Merely recording the expected and observed results is not enough; you should also identify how and why differences occurred, and show your understanding of the principles the experiment was created to study.

A lab report should contain the following:

1. Title page: containing the title of the experiment, your name, the name of the lab partners, the date, the teacher's name and the class

2. Introduction: The introduction states the purpose of the experiment and also provides the reader with any background and theory relevant to the lab.

Sample Introduction for a Flame Test lab:

By placing atoms of a metal into a flame, electrons can be induced to absorb energy and jump to an excited energy state, a quantum jump. They then return to their ground state by emitting a photon of light (the law of conservation of energy indicates that the photon emitted will contain the same amount of energy as that absorbed in the quantum jump). The amount of energy in the photon determines its color; red for the lowest energy visible light, increasing energy through the rainbow of orange yellow green blue indigo, and finally violet for the highest energy visible light.

In this lab record the flame test color of several metals by capturing droplets of solutions of salts, or ionic compounds of those metals with a platinum wire loop, then placing the loop into a bunsen burner flame. Record the colors of light observed and compare this data to the known electron arrangements for each metal tested.

3. Materials: list all chemicals and equipment used in the experiment

4. Procedure: describes the process in chronological order. Using clear paragraph structure, explain all steps in the experiment. A diagram is often helpful to illustrate apparatus or techniques. Be sure to include sufficient detail, for example:

"Hydrochloric acid was reacted with sodium hydrogen carbonate."	**NOT enough detail**
"5.05 g of $NaHCO_3$ was weighed into an evaporating dish. Approximately 6 ml of 6M HCl was obtained in a small beaker. The HCl was then added to the $NaHCO_3$ slowly using an eye dropper until the reaction appeared to be complete (no more bubbles were visible)."	**Enough detail**

Hint**:** If you are wondering if your procedure includes enough detail, ask yourself this, "Would another student be able to read it and duplicate what you have done?"

5. Data/Results: This is where you record what happened in the lab. Results include all measurements, data tables, calculations and graphs. Any formulas should be written out before data is plugged in.

6. Discussion: The discussion is the most important part of your report, because here, you show that you understand the theory behind the procedure. The following issues should be discussed:

- Compare actual results with expected results.
- Analyze experimental error to account for differences in results. If the flaws result from the experimental design, explain how the design might be improved. Avoid statements such as 'Human error was an issue, results could be improved by being more careful.'
- Explain your results in terms of background theory. Labs are intended to illustrate important laws, such as the Law of Conservation of Matter. Discuss how well the lab results illustrate this theory.

7. Conclusion: One or two sentences that state exactly what was found in the experiment.

8. References: Cite any sources of information you used in writing the report.

Voice/Tense: The entire report should be written in third person, past-tense, although future tense is acceptable in the introduction section. For example, when writing the procedure, instead of writing, "I will add 150 ml of HCl to a beaker" you should write, " A beaker was obtained and 150 ml of HCl was added." This is referred to as impersonal (passive) writing, which is always to be used in scientific documents. **Avoid all personal pronouns (I, we, etc.)!**

Marking Rubric (or Checklist)

Overall Presentation 5 pt

- ☐ title page containing all necessary components (**1pt)**
- ☐ typed or written neatly on one side only of white, unlined paper in blue or black ink (**2pt)**
- ☐ headings of each section should stand out and be separated by one line (**1pt)**
- ☐ marking checklist is included as the last page of the report (**1pt)**
- ☐ passive voice used throughout **(-0.5 pt/error, max 5 pts)**

Introduction 11pt

- ☐ The introduction is written in paragraphs which flow well with the proper use of transition statements. It does *not* read as a series of definitions and facts listed together. (**2pt)**
- ☐ background theory includes the following information: (**8pt)**
    - neutralization reaction: what this means
    - explanation of the process of titration
    - acids/bases definition
    - indicators – what they are and why they are used
    - explanation of the terms 'end point' and 'equivalence point'
    - what pH is
- ☐ the objective of this specific lab is clearly stated (**1pt)**

Materials 2pt

- ☐ the names of all equipment and chemicals used must be given in list form

Procedure 9 pt

- ☐ written in chronological order in well-flowing paragraphs (not steps) (**2pt)**
- ☐ contains sufficient detail to allow reproduction of the experiment if necessary *(could I read this procedure and repeat exactly what you did?)* (**-0.5 pt/missing details) (5pt)**
- ☐ a diagram of the apparatus, fully labeled and referred to in the procedure (**2pt)**

Results

- ☐ Write a balanced equation for the reaction (**2pt)**
- ☐ Give a properly labeled data table with all measurements taken for the experiment, drawn with a ruler if not done by computer (**2pt)**
- ☐ Calculate the average volume of NaOH used to reach the endpoint in the titration (you may drop any results that are outliers, as long as you state that you are doing so). (**1pt)**
- ☐ Calculate the molarity of the acetic acid solution used. (**3pt)**
- ☐ All work must be shown for all calculations, including units throughout. **(-0.5 pt/error)**
- ☐ Final answers must include units and the correct number of significant figures. **(-0.5 pt/error)**
- ☐ Points will be deducted for results outside a reasonable accuracy range. **(-0.5%/ 5% error)**

Discussion

- ☐ Explain how the process of titration allowed you to find the unknown concentration of the acetic acid. **(2pt)**
- ☐ Discuss a minimum of two possible sources of error that are related to the experimental procedure. **(2pt)**
- ☐ Suggest improvements to the experimental procedure that would help to remove the sources of error you discussed. **(2pt)**

Conclusion **2pt**

- ☐ In 1-2 sentences, restate what you did and what you found.