

Guidelines for Writing a Formal Laboratory Report

This format for writing up laboratory reports is known as *University Standard*. When individual lab reports are assigned, individual lab reports must be written. Plagiarized reports will receive a **MARK OF ZERO**.

Descriptive Title

e.g., "Determination of NaOH Concentration by Titration". The title is to be **DESCRIPTIVE** and in your **OWN WORDS**. (Not "Experiment #1")

Introduction (if required)

A good introduction should include all pertinent background information needed for a reader to understand the lab (i.e., definitions of terms used, historical background if appropriate, pertinent scientific laws and theories, chemical equations, mathematical formulas, and so on). After the background information has been provided, you must then include a concise **statement of the problem** that is being investigated in the lab activity. In senior science courses you may also be required to include a **hypothesis** (an "IF" and "THEN" statement suggesting a possible explanation for what you expect to observe, which can be adequately tested in the lab activity). If a hypothesis is required, include it immediately after the problem statement. Maximum $\frac{1}{2}$ page on a page by itself.

Abstract (if required)

THREE SENTENCES: (1) purpose of experiment; (2) how, in general, experiment was done, including amounts and concentrations of chemicals used; (3) result(s). Include balanced chemical equations when appropriate. Maximum $\frac{1}{2}$ page

Example of abstract:

(1) The purpose of this experiment was to determine the concentration of a solution of sodium hydroxide, NaOH. (2) This was carried out by titration against a hydrochloric acid solution of known concentration to a phenolphthalein endpoint. (3) The concentration of NaOH was determined to be 0.123 mol/L. The balanced chemical equation for this neutralization reaction is: $\text{NaOH}_{(aq)} + \text{HCl}_{(aq)} \rightarrow \text{NaCl}_{(aq)} + \text{H}_2\text{O}_{(l)}$

Materials

Make a list of all the materials used in the lab activity in **TWO EVEN COLUMNS**. If required, include a neat, labeled diagram. Use a ruler and pencil for drawing; you may use a pen for the labels. **NO GRID LINES OR BULLETS**

Procedure

Make a brief summary of what was done during the lab activity. The procedure must be a series of **NUMBERED STEPS** written up in the **PAST TENSE, PASSIVE VOICE**, describing "what was done" rather than "what you do." For example, write "1. The apparatus was set up as directed" and "2. Appropriate observations were made." Do not write statements such as "Set up the apparatus as directed" (present tense) or "We made appropriate observations" (active).

Observations

If descriptive (qualitative) observations are required, they should be written up in proper sentences and should generally describe what was seen **BEFORE** (e.g., the reactants in a chemical reaction), **DURING** (changes that occurred during the experiment), and **AFTER** (e.g., the chemical products) the experiment was completed.

Quantitative data must be recorded in table form. Some guidelines to follow:

- Tabulate data and/or list observations with a **DESCRIPTIVE TITLE**. e.g. Table 1. Titration of HCl by NaOH.
- Plot accurate graphs of quantitative data whenever appropriate.
 - use an appropriate descriptive title including all variables.
 - circle data points
 - label axes with units
 - use pencil
 - use a suitable scale
 - use grid paper
 - half a page or larger in size

Calculations

Whenever you have collected quantitative data, you must include sample calculations showing how your results were obtained. For example, if your experiment involved collecting data on mass and volume, and you are required to determine densities, you must show how you calculated the densities (using correct units). Include balanced chemical equations whenever appropriate. Use a suitable title. e.g. Calculations for Determination of NaOH Concentration by Titration. After showing a sample calculation for each calculation include all other answers in a titled table.

Conclusion(s)

A good conclusion is a concise (1-2 SENTENCES) summary statement that answers the question(s) posed in the original problem statement. Occasionally a summary of the findings made in the activity is also appropriate. For example, 2.31 g of propanol, C_3H_7OH , was distilled, representing a 58 % yield.

Discussion

A discussion follows the conclusion and allows you to extend the ideas developed during the lab activity. The discussion should also introduce concepts intended to help improve your thinking and problem-solving skills. In most labs that you do, you will simply be required to answer a set of prepared (ANALYSIS) questions. In some senior courses you may be required to prepare your own discussion.

Sources of Experimental Error

Sources of experimental error are **NOT** to include mistakes made by the experimenter (HUMAN ERROR), such as failing to prepare a burette properly, or not pressing the "tare" button on a balance before weighing a sample mass. These types of mistakes are controllable and therefore, if they occur, the experiment should be stopped and corrected to control this type of error.

Possible sources of error could include instrumental limitations, experimental design flaws, observing the system, or external influences.

- **INSTRUMENTAL LIMITATIONS:** Uncertainties are inherent in any measuring instrument. Rulers, electronic balances, graduated cylinders, etc, have varying levels of graduations of precision. Therefore, the experimenter should report the level of implied uncertainty in each measurement. For example, an electronic balance that records to 0.01 g should indicate its uncertainty of +/- 0.005g.
- **EXPERIMENTAL DESIGN FLAWS:** In the high school laboratory, only certain equipment is necessarily available to carryout the procedure. Occasionally, lack of sophisticated equipment can lead to lack of precision in the data or can cause error in the recorded data. For example, when calculating energy changes using a bomb calorimeter, two Styrofoam cups are often used with a thermometer and stirring rod poked through them to stir and record temperature. This setup is cost-effective but often is not air-tight which leads to error in the data.
- **OBSERVING THE SYSTEM:** Measurements are often needed to be made at numerous times during an experiment and often the measurement itself can cause error in the data. For example, if you need to measure the temperature of a hot liquid, you will dip a thermometer into it. This will inevitably cool the liquid slightly altering the "actual" temperature of the liquid.
- **EXTERNAL INFLUENCES:** External influences tend to be controlled by the experimenter and therefore tend not to have a major impact on the accuracy of the data. However, occasionally things such as a draught across an electronic balance pan (due to proximity to a fume hood) or from impurity of chemicals used (which could lead to competing undesired reactions).

In your sources of error section, you will a), list the error and indicate the type of error from the possible types of errors above, b), suggest whether the data should be higher or lower than recorded (YOU MUST CHOOSE ONE SIDE), and c), specifically explain why the error affected your result to be higher or lower than expected.

Remember, the result answers the problem being tested or purpose of the experiment, so focus your analysis on the big picture. If your result is based on a calculation(s) make sure to demonstrate how the error would affect the calculation.

To illustrate what you need to do, consider an experiment designed to calculate the rate of oxygen gas production, using the downward displacement of water technique to collect the gas, the following occurred: A bubble of air formed in the test tube prior to the start of the reaction.

A - List the source of error and identify the type of error. A bubble of air formed in the test tube during the transfer of the water-filled tube to the pneumatic trough. This error can be contributed to an experimental design flaw as an electronic gas collection instrument would be more precise and remove the chances of an air bubble in the test tube.

B - Indicate if the error caused the data to be higher or lower than expected. A bubble of air in the test tube will make the amount of oxygen gas collected appear to be higher than actually produced.

C - Explain SPECIFICALLY how the error affected your result. As the rate of oxygen gas produced is calculated by calculating the volume of oxygen gas collected in 60 seconds recorded in mL/s, additional air that is not oxygen gas will appear as oxygen gas and therefore appear as a larger rate of production of oxygen gas than expected.

Works Cited

If you have referenced any material in your lab report, you must include proper APA referencing in a works cited page at the end of your lab report. In addition, make sure to include referencing to your source WITHIN the body of our text. For example, According to the Merck Index (2001), the boiling point of water is 100°C. **Check out** my website **homepage** in order to see how to **source** in APA format.