



BASD HIGH SCHOOL FORMAL LAB REPORT



**WARNING: After an explanation of what to include in each section, there is an example of how the section might look using a sample experiment... Keep in mind, the sample lab used is VERY BASIC and does not always accurately represent the level of detail that might be needed for some of the sections!!*

GENERAL INFORMATION

- 12 pt Times New Roman font
- Entire report is DOUBLE SPACED, except the Materials section which is single spaced! *NOTE: The examples provided in this guide are single spaced to save paper!!
- 1 inch margins on all sides (top, bottom, left, and right)
- Always write in third person (AVOID use of “I,” “us,” “we,” etc. throughout the entire lab report)
- Write in full sentences, except for the materials list

IMPORTANT REMINDERS

Reports will be graded largely on their ability to clearly communicate and explain results and conclusions.

- Use proper English and spelling
 - PROOFREAD your report for style, grammar, and logic
 - Avoid being overly verbose (wordy) and flowery when attempting to convey your point; be concise
 - Avoid vague qualitative phrases such as “the results were quite close.” Be as specific and quantitative as possible
- Neatness and organization are important
 - Your report MUST be typed
 - Headings should be BOLD and hit enter after each
- Use significant figures and units for all measurements and calculations
- Be sure to follow the format described below
- Do not use material without citing the source. Do not copy verbatim (word for word) from the lab handout or any other source including lab partners. **Plagiarism, to any degree, will **NOT** be accepted!!

SECTIONS

1. Title and Heading: The title of the lab and heading should be left-aligned and include the following:

- Lab title
- Your name
- Name of partner(s)
- Name of class
- Name of teacher
- Due date of lab report

THE BOILING POINT OF WATER

John Smith

Partners: Jane Jones, Nancy Drew, and Danny Sanders

Course: Chemistry

Teacher: Mr. Magoo

Date: 26 November 2009

2. **Introduction: (*THIS IS A LONGER SECTION)** This section should connect the experiment to content covered in class as well as scientific knowledge on which the experiment is based.

- This section REQUIRES research to be performed (true research is NOT just one or two sources)
- Cite information obtained using IN-TEXT citations (NOT at the end of a paragraph only) using MLA format
- Connect lab concepts to class content... DO NOT CITE information that you now know from class!
- Try to make real world connections to the concepts studied in lab
- Keep a list of all sources used to be included in the Works Cited section

Introduction

Kinetic theory states that all molecules in matter are in constant motion (Kane 73). As these molecules absorb more energy they have a higher amount of random movement. As energy is absorbed in the form of heat the average kinetic energy (temperature) of the molecules will increase except during a phase change. The absorbed energy used in the phase change breaks the attractive forces between the molecules, thus transformation occurs in the orientation of the molecules. An example of a phase change would be the boiling point of water, which is a change from a liquid to a gas ("Water Properties"). This can be observed by using a temperature versus time line graph when the slope becomes zero. The boiling point of water is expected to be 100.00°C at 1 atmosphere air pressure.

3. **Objective:** The objective tells the reader the reason for performing the experiment.

- SINGLE sentence stating the purpose of the lab (put in your own words... do not use from the lab itself!)
- Clearly and concisely state the specific reason for doing the lab

Objective

The purpose of this experiment is to determine the boiling point of water.

4. **Hypothesis:** The hypothesis is a one-line sentence discussing how the problem will be solved.

- SINGLE sentence in IF / THEN format

Hypothesis

If water is heated for a period of 16 minutes, then the water should boil at 100 degrees Celsius.

5. **Materials:** This section lists all equipment used in the experiment.

- Use a bulleted list that is SINGLE spaced with a complete list included

Materials

- Beaker, 500 ml
- Distilled water, 300 ml
- Thermometer
- Hot plate

6. **Procedure:** The procedure is a step-by-step statement of how the experiment was performed.
- Quick version of the steps, but give enough detail so that the lab could be repeated using your steps
 - Use numbered steps
 - State any specific safety precautions
 - Use pictures and/or diagrams to illustrate apparatus setup, **ONLY IF NEEDED!**
 - Number any figures and state the number in the figure heading
 - Figure headings should be in bold print and placed below the figure
 - After each figure heading, include a short description of the figure

Procedure

1. The beaker was filled with approximately 300 ml of distilled water.
2. Place the beaker gently on the hotplate.
3. The thermometer was placed in the beaker and the initial temperature was recorded.
4. Switch on the hotplate and set to high.
5. The temperature was recorded every 2 minutes until 6 minutes after boiling began.
6. The hotplate was turned off and the materials were allowed to cool for at least 10 minutes before the equipment was dismantled.

7. **Data:** This section reports all observations, measurements, and trials performed.
- Present data in a TABLE whenever possible
 - Number each table and give each an appropriate HEADING as seen below!
 - Table headings should be in bold print and placed above the table... headings should include an appropriate short description of the data in the table
 - Don't forget to include the units!

Data

Table 1. Table displaying data obtained from the heating of water from 0 to 16 minutes

Time (mins)	0	2	4	6	8	10	12	14	16
Temp (°C)	20.05	41.46	60.62	79.39	97.11	99.68	99.51	99.51	99.51

8. **Analysis / Calculations: (*THIS IS A LONGER SECTION)** This section includes an analysis of the results, equations with sample calculations, error calculations, and statistics.
- DETAILED analysis of what happened in the lab (EXPLAIN what the results are telling you... do NOT just repeat the results again) and WHY
 - All results should be analyzed and explained fully (question and think about everything)
 - Discuss all possible sources of error (math / calculation mistakes or balance errors are NOT valid sources)
 - Suggest specific ways to change the experiment for improved results (how might you fix those errors)
 - Include only one example of each type of calculation... leave space after you type the Analysis in order to handwrite in all sample calculations (they can be typed in too) and be sure to include ALL of the following: equations used, sig figs, and units
 - Results of the calculations can be placed in the tables in the Data section as long as a sample is shown
 - Include % yield and % error calculations, **ONLY WHEN NEEDED**
 - When graphs are required, be sure to include a title, labels, and units

Calculations / Analysis

The initial temperature started off around 20°C because this was the temperature of the room. The water used was sitting at room temperature. If the water were not stored at room temperature, it would have been much colder coming out of the sink. Within the first two minutes, the temperature of the water almost doubled. This is caused by the molecules in the water speeding up due to the application of the heat from the hot plate. As the molecules are moving faster, the temperature increases. The water temperature continued to increase as more heat was applied because the water molecules continued to speed up. After 12 minutes, the temperature of the water remained the same at 99.51°C. This was due to the fact that the water reached its maximum temperature and was boiling. The boiling occurred because the vapor pressure of the liquid was equal to that of the atmospheric pressure at that temperature. According to other experiments, water is supposed to boil at 100°C. Although this difference is quite small, especially for a high school laboratory, the value was still lower than expected. The temperature of the water was slightly higher after 10 minutes of heating than it was when the temperature leveled off. This could be due some superheating that took place as the water was being heated.

Possible sources of error may be impurities in the water, which may have been present in the water to begin with or introduced from incompletely cleaned glassware. Air pressure was not measured, so some error could be due to the data being collected at a different air pressure. Improvements to the lab would include thoroughly cleaning equipment with distilled water before starting the experiment and measuring air pressure. By cleaning the materials with distilled water, any contaminants that might lower the boiling point of the water will be removed. The distilled water should be free of all impurities that might impact the data from the experiment. Since water boils at different temperatures due to atmospheric pressure, measuring the pressure that the experiment is performed will help improve the accuracy of the boiling point results.

Calculation of percent error:

$$\begin{aligned}\% \text{ error} &= \left| \frac{\text{theoretical value} - \text{experimental value}}{\text{theoretical value}} \right| \times 100 \\ &= \left| \frac{100.00^\circ\text{C} - 99.51^\circ\text{C}}{100.00^\circ\text{C}} \right| \times 100 \\ &= \frac{0.49^\circ\text{C}}{100.00^\circ\text{C}} \times 100 \\ &= 0.49\% \text{ error}\end{aligned}$$

9. **Conclusion:** The conclusion is a concise statement that state the results, indicates whether the hypothesis was accepted or not, and describes what has been learned from the lab.
- First sentence: state the results of the lab in ONE sentence
 - Second sentence: provide a one-line sentence stating that the hypothesis was supported or rejected
 - Discuss what was learned from the experiment
 - Incorporate the answers to any post-lab questions (do not list the questions or numbers here)... Make the conclusion flow into a nice summary of the lab and concepts

Conclusion

The boiling point of water was determined to be 99.51°C. The hypothesis was accepted. Boiling point of a liquid is reached when the vapor pressure of the liquid and the atmospheric pressure are both equal. Once this point is reached, the liquid will begin to boil. Dissolving a substance in a liquid will elevate its boiling point, as seen when salt is added to the water when cooking pasta. Atmospheric pressure is also important when determining the boiling point of a substance. This is the reason why cooking pasta at higher altitudes does not always result in the pasta being cooked fully because the temperature is not as high as it would be at lower altitudes. Adding salt to the water will help raise the boiling point at these higher elevations. Knowing the temperature a substance will boil is very important in cooking and other areas including industry.

10. Works Cited: Any information obtained from another source which is not common knowledge must be cited and the list of those sources is included here.

- List all sources of information (do not include lab handouts or things that are now known from notes)
- Use MLA format
- Place sources in ALPHABETICAL order
- Include the actual web address in the citation when citing a website
- Examples below include... Book and Website (with no author... author would come first if given)

Works Cited

Kane, Joseph W. *Physics*. New York: John Wiley & Sons, 1984.

“Water Properties.” *Water for All*, <http://www.waterforall.net/basics>. Accessed 11 Jul 2016.