**Lab Report Format**

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**GENERAL INFORMATION**

* Use the headings below to organize your lab report
* All labs must be typed in times new roman, 12-point font and double spaced
* Do not use personal pronouns (I, we, she, you)
* Do not use emotional words (believe, feel, seem, think, tried)

**COVER PAGE** – must include all of the following:

* Your Name and Block of the class
* Title of Experiment – it should describe the experiment. Consider what is being measured.

*Great Title:* Determining the Empirical Formula of Magnesium Oxide

*Bad Title:* Empirical Formula

* Due Date of the lab report

**RESEARCH QUESTION**

* Must be written in the form of a question.
* The question should include the independent and dependent variable. (How is Y dependent on X? What are you comparing? How does the independent variable affect the dependent variable?)

*Great Example:* How does temperature affect bacterial growth rate?

*Bad Example:* Why does bacteria grow?

**HYPOTHESIS**

In one or more sentences, explain:

* What you think is going to happen (your prediction)
* Explain why you think this will happen
* If it helps you explain your hypothesis, include background information
* If you used a graph in forming your hypothesis, also include it here

*Great Example:* As the mass at the end of the spring increases, the time period

will increase. This will happen because Newton’s 2nd law states that with twice the

mass the rate of acceleration will be halved.

*Bad Example:* I think the pendulum will speed up.

**VARIABLES**

* **INDEPENDENT VARIABLE** – This is the variable you changed; what are you testing. You can only have one independent variable. You must include units when used.

*Great Example:* mass of the ball in grams

*Bad Example:* mass

* **DEPENDENT VARIABLE** – The variable you are measuring; the result of the thing you changed. You can have only one dependent variable. You must include units when used.

*Great Example:* time in seconds it takes the ball to roll down the ramp

*Bad Example:* time

* **CONTROLS** – Identify all conditions that you kept the same between all trials. (You will most likely have many). You must include units when used.

*Great Examples:*

Angle of incline of the ramp (in degrees).

Total distance traveled by the ball (in centimeters).

*Bad Example:* Mass of the ball

**MATERIALS**

* Use bullet points to list ALL of the materials used in the experiment
* Make sure you are specific with the type of instruments used and the quantities and concentrations of any materials
* Do not include obvious things such as your body, lined paper or a pencil
* Do include materials required for safety precautions
* Every material listed should be used in the procedures

*Great Examples: Bad Examples:*

- 50 mL glass beaker - beaker

- 5.0 grams MgSO4 - Mg SO4

**PROCEDURES**

* Do not write in the first person with “I”, “we” or any other personal pronouns!
* Number each step in order
* Include all steps, including how to get and record the data
* You must have between 3-5 trials (unless specified by the teacher) for the dependent variable
* Be detailed – there should be no confusion about what to do next. Ask yourself: can someone else repeat the experiment exactly?
* If diagrams or drawings are helpful in clarifying the procedure, they should be included
* All items listed in Materials should have a use in the Procedure
* Include information on safety precautions

*Great Example:* Measure 28.3 mL of water using a 50.0 mL graduated cylinder.

 *Bad Example:* We measured water using a graduated cylinder.

**DATA COLLECTION & PROCESSING**

**Raw Data**

* Data tables must be easy to read and clearly labeled: all columns and rows need headings and units
* Put all trials within the same data table
* Provide a specific title for each data table. If there is more than one data table, number each sequentially (“Table 1”, etc.) followed by the title
* Include Qualitative Data. (*Example:* The solution color changed to clear to cloudy.)
* Include Quantitative Data. (The temperature changed from 25°C to 34.3°C within 63 seconds.)

*Great Example of a Table:*

Table 1 – Changes in Ionization Energy (IE)

measured in volts for atomic numbers 1-5

|  |  |
| --- | --- |
| **Atomic** **Number** | **Ionization Energy (IE)** **in Volts** |
| 1 | 13.53 |
| 2 | 24.46 |
| 3 | 5.64 |
| 4 | 9.28 |
| 5 | 8.26 |

|  |  |
| --- | --- |
| Atomic | IE |
| 1 | 13.5 |
| 2 | 24.4698 |
| 3 | 5 |
| 4 | 9.2 |
| 5 | 8.26 |

 *Bad Example of a Table:*

*TABLE 1*

*Also Required for all Junior & Senior Courses:*

* Uncertainties are mandatory and can be given within column headings for equipment precision

 and as footnotes beneath data tables for other types of uncertainties.

* The number of significant figures in the measurement is consistent with the uncertainty.

**DATA COLLECTION & PROCESSING (continued)**

**Processed Data**

* Headings are clear and equations being used are provided to show the reader what you are doing.
* An example of one set of raw data’s calculation is shown through completion. The other sets do not need to be shown yet the answers to their calculations should be shown.
* Units are provided.

**Graphs**: The best way to show your results on a data table is by making a graph.

* There are a variety of graphs and graphing techniques that you may use.
* Graphs and figures must both be labeled with a specific descriptive title. Identify with “Figure 1”, etc.
* Both axes on a graph must be labeled with specific units of measure. The independent variable should always be on the X-axis. The dependent variable is on the Y-axis
* Graphs are properly labeled and clear. (Graphing raw data only counts as processing if the best-fit line, gradient, etc. are determined.)
* You should discuss your graphs *in words* without making any conclusions.

*Good Example of a Graph:*

FIGURE 1 – Demonstrates changes in Ionization energy for atomic numbers 1-5

*Bad Example of a Graph:*

*Also Required for Junior & Senior Courses:*

* Uncertainties are propagated.
* Significant figures are followed (round at the end).
* You may have to include standard deviation and error bars (as determined by your teacher).

**CONCLUSION & EVALUATION**

**Conclusion**

* This section should be written in paragraph form.
* Restate the original research question and hypothesis.
* To write your conclusion, give *specific examples* from your results (data) to fully answer the research question. Explain how the results support or negate your hypothesis. Your conclusion should be fully supported by your actual data.
* Do not use the word “prove”; your data will not prove anything! Use “support” instead.
* Compare your results with data from the literature or known values, and cite your sources (using APA format).

**Evaluation**

This section should be written in paragraph form.

Discuss:

* Variables and controls of the experiment.
* The range of values and number of trials. Discuss any outlier (extreme or odd results) points.
* Sources of possible error. Discuss any factors that contribute to a lack of validity (were your results accurate?)
* Discuss whether your results for each trial are consistent/dependable AND did you do each trial exactly the same.
* Discuss limitations of the lab methods (*example:* measuring lung volume by exhaling into a balloon cannot measure residual capacity of the lungs).
* Improvements: what realistic and useful improvements could be made if you were to do this investigation again? How can random error be reduced? How can time management be improved?
* Furthering the lab: describe another problem related to this lab that you could further study to get a deeper understanding of the topic. You should consider how this lab activity is related to “real-world” concepts discussed in class, the textbook, or research.

*For Junior & Senior Courses Only:*

* + Compare the results with data values and calculate a percentage error between your results and a literature value.
	+ Compare the percent error to the uncertainty.
	+ Discuss any outlier points could be discussed (if there were any outlier points) as well as possible reasons for those outlier points.