Experiment 1:

Characterization of centrifugal and positive-displacement pumps

Group AB-A

09-06-2019

Group Member 1 (Task Leader)

Group Member 2

Group Member 3

# Introduction

## Purpose and Scope

Include the purpose and scope. Objectives must be specific, e.g.:

* Point 1
* Point 2
* Point 3

***The assignment memos are purposefully vague, so you must define more specific objectives.*** Otherwise, you will not have a clear purpose for your experiments and analysis.

## Relevant Theory and Literature

Summarize the relevant theory. This is my first equation:

(1)

Include key equations and sources but omit details such as derivations. Equations should be separate from the text and numbered. Here is a fake reference.1

*State your hypothesis here at the end*

# Materials and Methods

## Equipment

Describe available equipment and how you will use it to achieve your objectives.

Include a schematic showing all key devices, controls, and instrumentation.

## Procedure

Explain what data you will collect. Be as specific as possible. For example, give ranges over which variables will be adjusted number of measurements at each condition, etc.

## Safety Issues

Note safety issues for this experiment (omit "obvious" issues such as sharp objects, electrical power, etc. unless you believe there is a specific safety issue). Briefly note possible hazards of chemicals used.

# Results and Discussion

# Present your major results (in the form of graphs and/or tables), including estimated uncertainties. Do not put lengthy data or results tables here (those are for the appendices). Use the appropriate number of significant figures. Interpret and analyze your results. Also send the data files (Excel spreadsheets, Jupyter notebooks, etc.) that you used for sample calculation. The following example notes trends but lacks sufficient interpretation:

*"The data in Tables 1.1 and 1.2 show that for gases at low density, the viscosity increases with increasing temperature. For liquids, on the other hand, the viscosity usually decreases with increasing temperature."*

A potential interpretation of the observed trends:

*"This difference in temperature dependence is understandable from a molecular viewpoint. In gases, the molecules are free and travel long distances between collisions to transfer momentum (hence the low viscosity). As temperature increases, the mean molecular speed of the gas increases. This in turn increases the frequency of gas collisions and therefore increases the momentum transfer or viscosity. In liquids, the molecules are not free but closely packed into a 'cage' which prevents them from easy motion. Hence liquids are more viscous than gases. As temperature increases, there is more energy for each molecule to escape this cage and move more freely. Thus, the viscosity of liquids decreases with increasing temperature."*

Since the above is well-established, you could also say:

*"These trends agree with the standard molecular models of viscosity in gases and liquids [ref]."*

and provide an appropriate literature citation.

# Conclusion

Summarize your findings. Relate them to the objectives (as stated in your Introduction). Each conclusion must follow logically from information in the results and discussions sections.

# Recommendations

Recommend further actions, experiments, or improvements as needed. If desired, you may combine this sections with the Conclusions.

# References

**1.** Lewis LM, Edwards MC, Meyers ZR, Talbot Jr CC, Hao H, Blum D. Replication Study: Transcriptional amplification in tumor cells with elevated c-Myc. *Elife.* 2018;7:e30274.

# Appendix 1: Data and Results

Tabulate all data collected by the team that is not presented in the report. Add titles and units to make the table readable.

# Appendix 2: Sample Calculations

Show how you performed each calculation (including error propagation and statistical analysis). Organize in sections by calculation type, with a descriptive title or a brief paragraph between mathematical steps. Work through the calculation step-by-step for a typical case, first symbolically, then with numerical values (making it clear which raw data and/or literature values you are using). Include dimensions of all numerical values and results.

# Appendix 3: Supplementary Information (optional)

Items that support your results but are too detailed or lengthy to include in the main body, such as computer code. Organize by sections with descriptive titles. Each section must contain enough explanation to stand on its own.

# Member Contributions

Clearly state the contribution of each member in the report.