Writing a discussion

The Discussion

The discussion is the most important part of the laboratory report, because it is here that you demonstrate that you not only completed the experiment, but that you understand it. This section explains what happened in the experiment and how conclusions were made. The discussion allows for interpretation of the results with reference to theory, calculated values, or known values and describes the significance of the findings. This section provides the opportunity to account for any systematic or random errors and to make suggestions for how such errors might be eliminated.

The content of the discussion section depends on the nature and purpose of the investigation and on the kinds of results that are obtained. Therefore the features of the discussion vary widely, but often include the following:

Restatement of the purpose of the experiment and an indication of the methodology used
The discussion should begin with a brief review of the scientific goals of and approach used in the investigation. Remember that it is never appropriate to state, “The purpose of this experiment was...”

Summary of what the results were and how they were calculated
Each equation used should be stated and the variables defined. Each equation should be set off on its own line of text and numbered. A narrative account of the results should also be included. The discussion should indicate the major conclusions drawn from the results.

Comparison of experimental and expected results
Whenever possible, experimental results should be compared to literature values or expected values.

Analysis of experimental error
A brief description of the major sources of experimental error should be included. If there were differences between the experimental and expected results, how can you account for them? Incorrect calculations, math errors, and rounding errors are NOT sources of experimental error (and pleading "human error” implies that you are incompetent). Your discussion of error should include an analysis of how the error is likely to affect the results. If the errors result from the experimental design, explain how the design might be improved.

Explanation of results in terms of theoretical issues and goals of the experiment
In this portion, discussion begins to shift from the specifics of this procedure to the more general implications of the investigation. State to what extent and in what ways the results of the experiment are (or are not) in keeping with accepted theory and relate the results to the broader concepts of chemistry.

On the next page is an example of a well-written discussion for an introductory chemistry experiment.
The heat capacity of a homologous series of liquids was measured using solution calorimetry. A measurement of the current (I) and voltage (V) delivered to the heating coil along with the heating time (∆t) were used to determine the amount of heat supplied to the calorimeter system.

\[ q = IV \Delta t \]  

(1)

The measured heat capacity of the system was calculated from the amount of heat deposited and the measured temperature change, ∆T.

\[ C_{\text{meas}} = \frac{q}{\Delta T} \]  

(2)

Finally, the molar heat capacity of the liquid (C_{mol}), or calorimeter (C_{cal}), was calculated by assuming that the heat capacity of the system is the sum of the heat capacity of each part of the system.

\[ C_{\text{meas}} = nC_{\text{mol}} + C_{\text{cal}} \]  

(3)

Figure 1 shows that the molar heat capacity of the liquid increased with increasing molecular complexity as measured by the number of atoms in the molecule. Water, with three atoms, had a molar heat capacity of 75.29 J/mol K, methanol, with six atoms per molecule had a heat capacity of 78.4 J/mol K, and ethanol with ten atoms per molecule had a heat capacity of 108 J/mol K.

![Figure 1: Trend in heat capacity as the number of atoms in the molecule increases.](image)

The measured heat capacities agreed well with values found in the literature. The measured heat capacity of methanol had a 4% difference from the literature value of 81.6 J/mol K. Likewise, the measured value for ethanol was different from the literature value of 112 J/mol K by 4%. These differences are well within the accepted limits for this type of measurement.

More accurate values could be obtained by insulating the calorimeter against heat transfer to the environment to ensure a more adiabatic system. The large discrepancy in the two measurements for the heat capacity of the calorimeter can be explained if the system is not adiabatic. At the lower current setting, the heating is accomplished over a longer time interval. If there are significant heat leaks, the longer heating period will result in more heat transferred to the environment. The apparent heat capacity of the calorimeter will depend directly on the amount of heat transferred to the environment. Thus, the fact that the heat capacity of the calorimeter was significantly larger for the lower current setting is consistent with the fact that the calorimeter is not entirely adiabatic.

References
Allegheny College Chemistry 115 Laboratory Manual, 2002
Engineering Communication Centre at the University of Toronto; http://www.ecf.utoronto.ca/~writing/handbook-lab.html#Discussion
The Writing Center at the University of Wisconsin; http://www.wisc.edu/writing/