Writing the *Theory* Section of a Full Formal Report

A discussion of the theory, including details, should be presented when it is needed to understand the analysis or calculations presented in the report. The theory can include the derivations of equations, explanations of physical behavior, or both. A detailed description of the theory is included in the body of the report if it can be done so without detracting from the overall presentation. An alternative is to place detailed derivations or descriptions in an appendix.

The *Theory* section will often include developments based on fundamental analysis tools such as free-body diagrams or energy balances. In this section, it is appropriate to present governing equations, schematic diagrams, or brief derivations that will aid in understanding why various experiments were performed. New theories or techniques developed should be described in this section.

An error analysis may be appropriate in the *Theory* section. It might also be appropriate in the Method, Results, or Discussion of Results sections. For certain, some form of uncertainty analysis is always needed. There is no such thing as an exact measurement and it is unclear what is meant when data are described simply as being "accurate." Before any data can be interpreted or a conclusion drawn, the relative accuracy of the data must be understood.

If symbols used in equations are not universal (which they seldom are), be sure to explain them at the point of first use. Set equations separately from text, unless they are simple equations used only in a single paragraph. Number equations for further reference. Equation numbers are usually placed in parentheses and aligned with the right margin. Equations can be either set at a fixed tab stop or centered on the page; they are usually indented from the body of the text. Be sure to be consistent in numbering and format throughout your report.

From a procedural point of view, the theory drives the development of the experimental method and the selection of the experimental apparatus. The experiments you perform and the apparatus needed to perform the experiments will be determined largely by the relationship between your objective and the underlying theory. Every experiment is designed to test some hypothesis. The theory should allow you to develop the hypothesis. Without the supporting theory it is impossible to perform a relevant experiment.

A further use for the theory is in the preliminary evaluation of experimental data. Many experimental errors are large enough to be caught just by making a preliminary comparison between the data and the results predicted by the theory. If you fail to catch large experimental errors until after your experimental setup is dismantled, you face a lot of unnecessary work to retake the data. By comparing your raw data to the theory at the time of the experiment, you may save yourself from a lot of frustration.

As an aid to report writing in general, the use of personal pronouns should be mentioned. In the past, no personal pronouns (I, me, we, or us) were allowed in technical writing.
Now, the use of we and us (collective pronouns) is acceptable, but never the individual pronouns I and me. If you did the work yourself, you should still use the "royal we" to indicate the things you did. It is probably appropriate to minimize use of the personal pronouns; use them where the third person form ("the authors") is awkward.