CHAPTER

NINE

GUIDELINES FOR REPORT WRITING

REPORT WRITING

&

SAMPLE PAGES FROM LABORATORY REPORTS

1. Report Writing

The report is a written presentation of what was done in an experiment. It also indicates the student's approach to the problems involved, to the interpretation of the work by others and to the analysis and interpretation of new observations and results.

1.1. The Parts of a Scientific Report

1. ***Cover Letter*** is a letter of transmittal, which should be used to submit the report. *It is not a part of the report.* This letter is attached to the outer part of the report cover; it is not bound into the report. The letter should contain the name and the address of the person it is submitted to and the names and addresses and signatures of the persons who have prepared the report. The purpose of the report and by whom the assignment has been given should be indicated as well as the report title and date.

2. ***Cover Page*** is the first part of any communication. It shows the course code and the course title, the number and title of the experiment, the names of the students who performed the experiment (surnames in alphabetical order), the date on which the set of experiments were performed, group number, the submission date of the report, and to whom the report is submitted including the name of the course instructor and the graduate assistant.

3. ***Abstract*** gives a brief summary of the report contents, emphasizing the results and conclusions. Its purpose is to briefly summarize the intent with which the report has been prepared, the methods of study, the basis of calculations, quantitative results and conclusions. Abstract should not refer to any part of the report and no references should be cited in this section. It should be no more than a page in length and should consist of a single paragraph.

4. ***Table of Contents*** shows the organization of the report giving page numbers of the chapters and sections. Main headings and subheadings in the report body should follow the sequence and the names stated in this section.

5. ***List of Figures*** and ***List of Tables*** give separate lists of figure and table captions exactly as they appear in the report with the corresponding page numbers.

6. ***Introduction*** gives with a clear statement of the problem indicating the scope of the work. This section should indicate the aim and relevance of the experiments, including the plan of attack to the problem solution and the overall report structure. The introduction should make the reading and understanding of the report easier. Therefore, it should be short and should answer the following questions: What did you write about? What segment of the subject did you investigate? Where did you get your information? In what order are the data presented? Students may also include a brief reference to other relevant investigations to show how the work to be reported is based upon earlier work. They can also mention any new approach, any limitations and any assumptions upon which the work is based. Whatever objectives you list here must be reported on in the Conclusions section.

7. ***Theory*** gives a detailed discussion of the theoretical background of the experiments involved and the methods used in evaluating the data. The necessary equations should be given, derived, explained and numbered in this section. The theory should explain all equations, theoretical principles, and assumptions that are used in the experiment and the analysis. The primary purpose of the theory section is to show how the raw data is manipulated to become results. Relevant equations used are to be presented and described to illustrate their basis and origin. Define all variables used in the equations. Care should be taken not to go too deep into less relevant subjects. Theory section is limited to 10 pages.

8. ***Experimental Setup*** includes a detailed explanation of apparatus, materials and chemicals used in the experiments. Use sketches, diagrams or photos, to describe the experimental set-up. Label the main components. Provide dimensions and material of test samples where applicable.

9. ***Procedure*** gives a detailed explanation of how the experiment was actually performed including the methods used in sampling. This section should be sufficiently detailed so that someone with a similar background and training could repeat the observations and obtain similar data. Passive voice should be used to illustrate the steps of the experimental procedure.

10. ***Sample Calculations and Results*** section should provide a factual statement of what was observed and include the results of the analysis of the data (as tables, graphs, statistics) together with the sample calculations. The original (raw) data should be included as tables in the Appendix section. Refer to the equations in Theory section, if you rewrite an equation, do not give new numbers. The tables in this section should be the summaries of the important results obtained by calculations. All tables and figures should be accompanied by comments in the text of report.

Detailed explanations and comparisons can be postponed to the Discussion section.

11. ***Uncertainty Analysis*** shows the 'goodness' of the results. The errors in experiments can be systematic or random. In this section, the uncertainty for every experimentally measured quantity should be analyzed and the deviation of the experimental results should be stated.

12. ***Discussion*** should be an objective consideration and interpretation of the results given in the previous section and should lead naturally to main conclusions. This section includes a detailed explanation of the results in the calculations including the graphs and data tables. The calculation methods adopted in the report, their precision and accuracy, the sources of errors in data, the mathematical models used to express the data, the fit between the data and the models, the error propagation, the effects of the various independent parameters on the results, the statistical analysis of the results, shapes of the curves, etc. should be discussed in detail. Tell why things happened, not only that they did happen. This section should be divided into subsections, if possible.

13. ***Conclusions and Recommendations*** section is the final section of the text. The conclusions are an expanded counterpart of those found in the abstract. Here, the complete set of conclusions implied or stated in the results and discussion sections should be given in logical order. Conclusions should not be stated as opinions, but rather follow logically from the data presented. This section should also show how nearly the objectives set forth in the introduction are attained. Recommendations for improvements, possible applications and future work related to the specific project should be given based on the conclusions presented. State your discoveries, judgments and opinions from the results of this experiment. Make recommendations for further study. Suggest ways to improve the results of this experiment.

14. ***References*** list is a mandatory list of the literature sources (books, journals, proceedings, web pages) used in report preparation. References to all external work must be listed here. They can be given in two ways. Firstly, they can be given in alphabetical order at the end of the report. Within the text, each reference should include the last name of each author followed by his initials. References can be listed in the text such as (Smith, 1989) in the case of single author; (Smith and Jackson, 1989) in the case of two authors; (Smith *et al.*, 1989) in the case of more than two authors. If there are two references cited for an author in the same year, then the references can be distinguished as (Smith, 1989a) and (Smith, 1989b).

Secondly, they can be given in numerical order according to their order of appearance within the text. The numbered reference citation within text should be enclosed in brackets. In case of two citations, the numbers should be separated by a comma [1, 2]. In the case of more than two references, the numbers should be separated by a dash [5-7].

If any online references are present, they should be cited in the text with a number enclosed in brackets [8] or (source, year). Full details of internet source, e.g. the author name, preparation year, the title of the web page and URL information should be given in your list of references.

15. ***Nomenclature*** is a list of all the symbols appearing in the report including their definitions. SI units should be used in the reports, unless the use of other units is absolutely necessary. The symbols must be listed in alphabetical order. The subtitles include Latin letters, Greek characters, subscripts and superscripts.

16. ***Appendix*** section contains the detailed source of findings presented in the report that the reader may not wish to read. Appendices are identified by capital letters starting with "A" and continuing through the alphabet as necessary. Supplementary materials, such as raw data taken during the experiments, calibration charts, physical and chemical properties of the materials used in the experiments, detailed derivations, detailed calculations including graphs and tables, computer programs and outputs, can be presented in separate appendices.

1.2. Formatting Guide for Written Reports

The rules set forth here are for the guidance of the students preparing reports for ChE 302 - Chemical Engineering Laboratory I and ChE 401 - Chemical Engineering Laboratory II courses.

- Lab reports must be submitted on standard "A4" size (210 x 297 mm) paper and in bound form.
- As a character font, use Times New Roman. The font size must be 12 point in the text. Main headings should be in 12 point and bold typeface.
- Spacing of the text material should be 1.5.
- Be careful with the significant figures and try to be consistent.
- Margins of pages should conform to the following specifications:
  Left - 2.5 cm, Right - 2.0 cm, Top - 2.0 cm and Bottom - 2.0 cm from the edge of paper.

- All pages must be numbered, including appendices. The preliminary section, i.e., Cover Page, Abstract, Table of Contents, List of Figures, List of Tables should be numbered using lower case Roman Numerals, e.g., i, ii, iii, etc. The title page counts as Page i, but the number should not appear. For the remainder of the report Arabic numbers are used. Page numbers should be placed at right top edge of the page. The numbering in the main body of the report should begin with Page 1 (Introduction) and run consecutively to the last page. Each section (2. Theory, 3. Experimental Setup, 4. Procedure, …) should start on a new page.
- All figures and tables must be numbered and have a title. Numbering of the figures and tables should be consistent with the section of the report in which they appear, such as Table 5.8, Figure 3.1 and Table A.1. (No need for 2.1.3., 5.2.8., etc.). All information on figures and tables should be large and easily readable.
- Captions for figures should appear below and captions for tables should appear above.
- Figures should be located within the page margins, centered and preferably within a frame.
- References should be correctly cited for any figure or table taken from the literature.

1.3. Basic Requirements for Scientific Writing

Clarity - The clear thinking in the statement of the problem, in formulating the hypothesis upon which the work is based and in planning the work should be reflected throughout the report.

Completeness - Every statement should be complete, every line of argument should be explained in detail and followed by a logical conclusion.

Impartiality - Any assumptions underlying your arguments should be made clear. Students should i) indicate how, when and where the data were obtained, ii) specify the limitations of the work and the sources of error and probable errors in the data. The evidences that are against the given hypothesis should not be omitted. Any assumption, extrapolation or generalization should be based on sufficient evidence. Any assumptions, conjectures and possibilities discussed, should not be referred to later as if they were facts. Words like ‘obviously, surely, of course’ have to be used carefully because they may introduce an assumption. Every statement should be based on evidence and not on unsupported opinion. Therefore, excessive qualifications should be avoided, e.g. possible, probable, perhaps, it is likely to... In scientific writing, do not endow inanimate things or even living organisms other than people with human attributes. Scientists should not write that “the results suggests”, nor that “an experiment suggests”, since these things cannot suggest.

Accuracy - The scientific method depends upon care in observation, precision in measurements, care in recording these observations and measurements and care in their analysis. Every experiment should be repeatable and every conclusion should be verified in the report.

Order - Students should present information and ideas in a logical order.

Simplicity - Simplest explanation in accordance with all the evidence should be preferred. The first words and last words in a paragraph attract most attention. Therefore, you should never begin a paragraph with unimportant words. Omit superfluous phrases such as: "First let us consider..." Superfluous introductory and connecting phrases distract the reader's attention (Table 1.1). Use short words and simple sentences. Long sentences may indicate that you have not thought sufficiently about what you wish to say. Prefer the direct word to the circumlocution.

Table 1.1. Introductory and connecting phrases which can usually be deleted without altering the meaning of the sentence.

It is considered, in this connection, that...
From this point of view, it is relevant to mention that...
In regard to..., when we consider..., it is apparent that...
As far as... is concerned, it may be noted that...
It is appreciated that... in considering...
It is of interest to note that... of course...
In conclusion, in relation to..., it was found that...
From this information it can be seen that...in so far as...
It is known from an actual investigation that... as follows:
It has been established that, essentially,... in the case of

Table 1.2. Circumlocution: the use of many words where few would do better.

Circumlocution	**Better English**
if at all possible	if possible
mechanisms of a physiological nature	physiological mechanisms
on an experimental basis	by experiment
working towards a unanimous situation	trying to agree
by any actual person in particular	by anyone in particular
to show the same high level of application	to keep trying
several ... are known to influence	several ... influence
measures on purely local terms	local action
a maximum depth of ten meters	ten meters deep
over a period of the order of a decade	for about ten years
during the month of April	in April
on a theoretical level	in theory
An account of the methods used and the results obtained has been given by...	Their methods and results are described by
... in establishments of a workshop rather than factory character	... in workshops...
It consists essentially of two parts.	It has two parts.

Table 1.3. Circumlocution: some phrases which should not be used if one word would do better.

Circumlocution	**Better English**	**Circumlocution**	**Better English**
In view of the fact that	because	it is assumed that	if
on account of the fact that	as	a sufficient number of	enough
at that point in time	then	in all other cases	otherwise
during the time that	while	carry out experiments	experiment
with the exception of	except	make an adjustment to	adjust
which goes under the name of	called	make an examination of	examine
with the result that	so	undertake a study of	study
are found to be in agreement	agree	take into consideration	consider
conduct an investigation into	investigate	in connection with	about
after this has been done	then	in conjunction with	with
it is apparent therefore that	hence	at the present time	now
have been shown to be	are	until such time as	until
for the purpose of	for	try out	try
aimed at	for	open up	open
prior to	before	in regard to	about
a number of	several	in all cases	always
proved to be	were	in most cases	usually
in order that	to	a proportion of	some
not infrequently	often	in the event that	if
has an ability to	can	a large number of	many

Technical Level

- Existence of all items requested
- Logical progression of sections
- Appropriate use of subtitles
- Existence of correct reasoning for all items covered
- Absence of meaningless, superfluous or false arguments
- Sufficient information for reader to understand everything
- Correct reference to attachments and literature

Quality of Calculations

- Existence of titles and subtitles in the sample calculation
- Origin of the data is identified
- Symbols are defined
- Equations are identified
- Results are highlighted
- SI units are used
- Sufficient information for reader to follow and understand the calculations

Quality of Drawings, Graphs, and Tables

- Identification by number and title
- Correct layout on the sheet
- Requested margins on the sides of the page
- Figures self explanatory and have high readability

Quality of Editing

- Good sentence and paragraph structure and transitions
- Spelling and grammar checked
- Absence of superfluous words, incomplete and nonsense sentences
- Existence of continuous and easily readable text

February 13, 2020

Ms. Burcu Acar
Department of Chemical Engineering
Boğaziçi University
Bebek, Istanbul

Dear Ms. Acar,

Attached is the report on the "Coil Type Heat Exchanger" performed on February 6, 2020 as a requirement of the ChE 302 course.

In this laboratory work, the aim was to determine the overall heat transfer coefficient of a coil type heat exchanger. Also, the effects of variation of liquid and steam flow rates on inside and outside heat transfer coefficients were investigated.

Our report comprises the introduction to the subject, the details of the experimental set-up and procedures, experimental results, sample calculations, and their discussion, followed by conclusions and recommendations.

We have aimed to present a fulfilling report on the subject. Please contact us for any further questions.

Respectfully yours

signature	signature	signature	signature
Team Member 1	Team Member 2	Team Member 3	Team Member 4
e-mail	e-mail	e-mail	e-mail

ChE 302

Chemical Engineering Laboratory I

COIL TYPE HEAT EXCHANGER

Experiment No: 4.6

by

Team Member 1
Team Member 2
Team Member 3
Team Member 4

Course Instructor	: Assoc. Prof. Burak ALAKENT
Submitted to	: Name of Assistant
Date of Performance	: Day.Month.Year
Date of Submission	: Day.Month.Year
Group Number	: ##

Department of Chemical Engineering
Boğaziçi University
Bebek, Istanbul

DECLARATION OF INDEPENDENT WORK

- WE HEREBY DECLARE THAT THIS REPORT CONTAINS OUR OWN INDEPENDENT WORK AND THAT WE HAVE NOT RECEIVED HELP FROM OTHER GROUPS.

- WE CONFIRM THAT WE HAVE NOT COMMITTED PLAGIARISM IN THE ACCOMPLISHMENT OF THIS WORK, NOR HAVE WE FALSIFIED AND/OR INVENTED EXPERIMENTAL DATA.

- WE ACCEPT THE ACADEMIC PENALTIES THAT MAY BE IMPOSED FOR VIOLATIONS OF THE ABOVE.

Name:

Name:

Name:

Name:

Date:

ABSTRACT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

2. THEORY

2.1. Subsection

$$Re = \frac{\rho V D}{\mu} \tag{2.1}$$

Table 2.1 Dependence among various parameters for horizontal pipe flow.

2.1.1. Sub-subsection

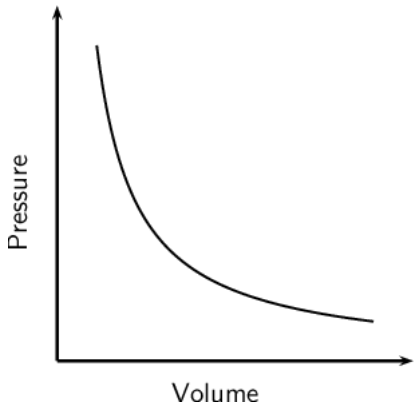

Figure 2.1 Time dependence of fluid velocity.

2.2. Subsection

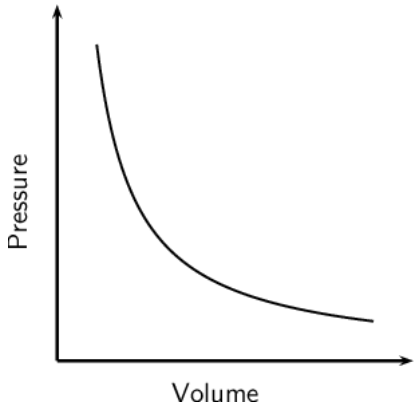

Figure 2.2 Pressure distribution along a horizontal pipe.

3. EXPERIMENTAL SETUP

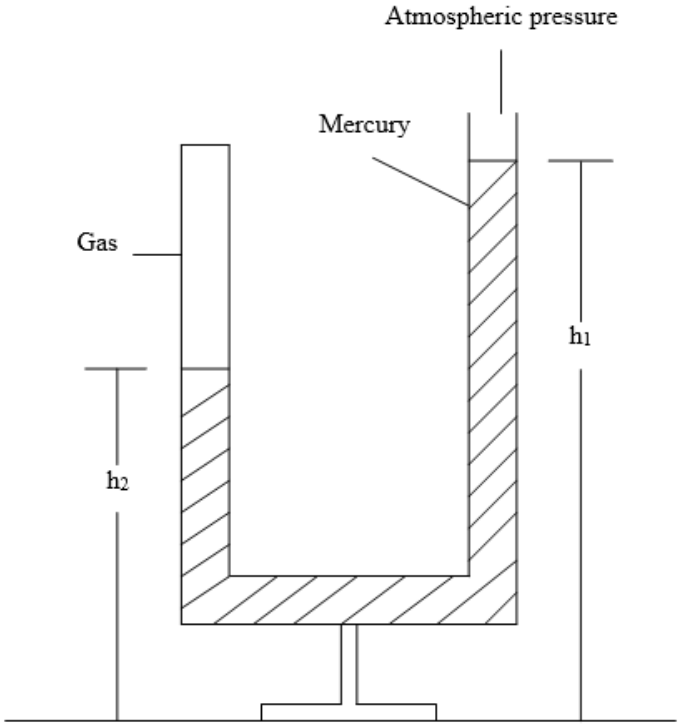

Figure 3.1 Reynolds setup.

4. PROCEDURE

5. SAMPLE CALCULATIONS AND RESULTS

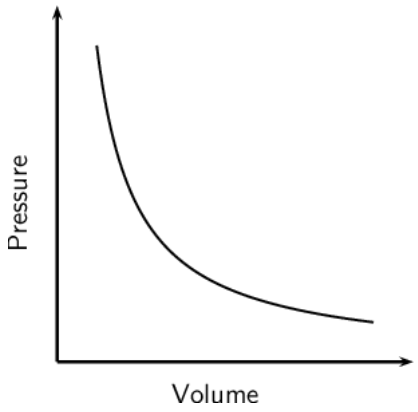

Figure 5.1 Correction chart for volumetric flow rate with power function.

6. UNCERTAINTY ANALYSIS

7. DISCUSSION

7.1. Subsection 1

7.2. Subsection 2

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. Conclusions

8.2. Recommendations

REFERENCES

Akın, H. L. and T. Taşol, 1991, "Nuclear Reactor Control Using Back Propagation Neural Networks", Proceedings of the Sixth International Symposium on Computer and Information Sciences, Side-Antalya, 30 October-2 November 1991, Vol. 2, pp. 889-905, Amsterdam, Elsevier.

Banerjee, P. K. and R. Butterfield, 1980, Development of Boundary Element Methods, Applied Science Publishers, London.

Bennett, C.O. and J. E. Myers, 1962, Momentum, Heat, and Mass Transfer, McGraw-Hill.
Doebelin, E., 1985, Control System Principles and Design, New York, John Wiley.
Drucker, D. C., 1983, "Photo Elastic Separation of Principal Stresses by Oblique Incidence", Journal of Applied Mechanics, Vol. 65, pp. 156-160.

Efstathiou, J., 1987, "Rule-Based Process Control Using Fuzzy Logic", Approximate Reasoning in Intelligent Systems, Decision and Control, pp. 145-158, Oxford, Pergamon Press.

Perry, R. H., D. W. Green, and J. O. Maloney, 1984, Perry's Chemical Engineers' Handbook, McGraw-Hill.

Schneider, J., 2010, "The Extrasolar Planets Encyclopaedia", http://exoplanet.eu/catalog.php.

Shah, Y. T., S. P. Godbole and W. D. Deckwer, 1982, "Design Parameters Estimations for Bubble Column Reactors". AIChE Journal, Vol 28, pp. 353-379.

Smith, R., 2002, "Conformal Lubricated Contact of Cylindrical Surfaces Involved in a Non-Steady Motion", Ph.D. Thesis, http://www.cas.phys.unm.edu/rsmith/homepage.html.

OR

REFERENCES

1. Ning, X. and M. R. Lovell, "On the Sliding Friction Characteristics of Unidirectional Continuous FRP Composites," ASME J. Tribol., Vol. 124, No. 1, pp. 5-13, 2002.

2. Barnes, M., "Stresses in Solenoids," J. Appl. Phys., Vol. 48, No. 5, pp. 2000-2008, 2001.

3. Jones, J., Contact Mechanics, Cambridge University Press, Cambridge, UK, Chapter 6, 2000.

4. Lee, Y., S. A. Korpela and R. N. Horne, "Structure of Multi-Cellular Natural Convection in a Tall Vertical Annulus," Proc. 7th International Heat Transfer Conference, U. Grigul et al., eds., Hemisphere, Washington, DC, 2, pp. 221-226, 1982.

5. Hashish, M., "600 MPa Waterjet Technology Development," High Pressure Technology, PVP- Vol. 406, pp. 135-140, 2000.

6. Watson, D. W., "Thermodynamic Analysis," ASME Paper No. 97-GT-288, 1997.

7. Tung, C. Y., "Evaporative Heat Transfer in the Contact Line of a Mixture," Ph.D. Thesis, Rensselaer Polytechnic Institute, Troy, NY, 1982.

8. Kwon, O. K. and R. H. Pletcher, "Prediction of the Incompressible Flow Over A Rearward-Facing Step," Technical Report No. HTL-26, CFD-4, Iowa State Univ., Ames, IA, 1981.

9. Smith, R., "Conformal Lubricated Contact of Cylindrical Surfaces Involved in a Non-Steady Motion", Ph.D. Thesis, http://www.cas.phys.unm.edu/rsmith/homepage.html, 2002.

NOMENCLATURE

Latin Letters

A	Controller system matrix
A	Cross sectional area, cm^2
a	Pore radius, mm
C	Concentration, mol/lt
C_p	Heat capacity, J/K.kg
H	Enthalpy, J/kg
Re	Reynolds number

Greek Letters

Δ	Difference
ε	Void fraction
η	Effectiveness factor
ρ	Density, kg/m^3

Subscripts

avg	Average
b	Bulk
g	Gas
L	Liquid
S	Catalyst surface

Superscripts

eq	Equilibrium

APPENDIX A: Original Data

Table A.1 Original data of volumetric flow rate for run 1.

Table A.2 Original data of volumetric flow rate for run 2.

APPENDIX B: Derivations