

TECHNICAL REPORT GRADE SHEET

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Heat Transfer Analysis

Experiment: in Solids

Project # _____

Date: _____

Section # _____

Report Grade: _____

Group # _____

E1: _____

E2: _____

E3: _____

Criteria	Description	Points Possible	Points Received
Cover Memo or Abstract	Complete. State objectives. Gives precise "big picture" statement of most important results and conclusions. State methods as needed.	10	
Intro. & Objectives	Interesting, relevant. Objectives clear, concise, quantitative, specific to project.	10	
Literature Review	Three research articles. Relevant. Concise but informative summary. Good schematic and discussion thereof. Relates measurements to data	10	
Apparatus and Procedure	needed to meet objectives. No 2 nd person. Not written to operator or technician. Does not assume Instructor has prior knowledge.	10	
Principles/ Equations	Complete and correct. Relates to objectives. Shows physical meaning. Relates to experiments. Equations numbered. Standard symbols used. Sufficient references. Does not assume instructor's prior knowledge.	10	
Experimental Plan	Concise but clear description of the conditions, levels, exact runs performed. Total number of runs.	5	
Results and Discussion	Logical and orderly. Relates to project objectives. Each figure and table called out & discussed thoroughly. Good topic sentences followed by strong paragraphs. Each observation and conclusion supported. Thorough. Does not assume Instructor has prior knowledge. Critical Thinking!	20	
Conclusions	Supported by Results and Discussion. Consistent w/ Objectives. Repeat quantitative, specific findings. Relevant and useful. Critical Thinking	5	
Literature Cited	Cite all relevant journal articles, books, handbooks, etc. wherever needed in the main body. Use standard (ACS Guide) methods to call out citations. Provide complete bibliographic info. In the Lit. Cited section. No footnotes. Minimize direct quotes. No titles cited in the text.	5	
Appendix I	Copies of Laboratory Notebook pages.	5	
Appendix II	Copy of Sample Calculations.	5	
Appendix III	Copy of three articles cited in Lit Review.	5	
Lab Notebook Appendix	Submit raw data; copy pages from notebook	5	
Documentation Appendix	Document sample calculations; provide sufficient narrative, working equations, units, etc. so that TA can follow the calculations.	5	
Appearance	All required sections. Margins observed. Neat handwriting if necessary. Stapled or clipped. Neat. Conform to Lab Manual instructions	5	

TECHNICAL REPORT GRADE SHEET

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Figures	Informative titles and legends. Only 1 title per fig. Clear symbols and lines. Corrected Excel or PowerPoint defaults. Margins. Large enough to read. No excessive frames or borders. Discuss every figure. Capitalize "Figure x"	5	
Tables	Informative titles and headings. Describe content of tables (columns & rows). Only 3-4 significant digits. Show units. Useful information. Corrected Excel or PowerPoint defaults. Margins. Large enough to read. No excessive frames or borders. Discuss every table. Capitalize "Table y"	5	
Grammar and Spelling	Check verb use with "data." Complete sentences. Homonyms. Apostrophes. Minimal use of possessives. No 2 nd person. Noun / verb agreement.	5	
Digital Report	CD Included with the final report (in a single word document) and all files used to calculate the results recorded.	10	
Required Content			

Lumped capacitance method

1	Look up the thermal conductivity (k), the density (ρ), and the specific heat (C) of the pure metals. Calculate the thermal diffusivity.	6.35	
2	Calculate, plot, and tabulate the dimensionless centerline temperature as a function of time.	6.35	
3	Calculate the Fourier number as a function of time.	6.35	
4	Using the lumped capacitance method, determine the best single experimental value of the convective heat transfer coefficient h for each metal and each shape. Compare the values of h obtained from each pure solid. If you also obtained data under free convection conditions, use the same analysis to compute h_{free} and compare these to the values of h obtained from the stirred (forced convection) experiments.	6.35	
5	Using the best value of h , compute the dimensionless temperature as a function of time and plot the results, comparing to the actual experimental data. How good is this model and the parameter h ?	6.35	
6	Considering the Biot number, discuss whether the lumped capacitance approach seems valid to determination of h .	6.35	

Analysis with convection plus internal conduction

7	For each experiment, calculate the Fourier number from the experimental data. Locate the regime where the truncated (one-term) solutions given in this handout are valid.	6.35	
8	Linearize the one-term solution, and plot the data. Perform linear regression to determine C_1 , ζ_1 , and Bi . Using those values back predict θ . Also back predict θ from your experimental results.	6.35	

9	From the value of ζ_1 , compute the Biot number and then the heat transfer coefficient h . Tabulate h for each shape and each type of convection, forced and free.	6.35	
10	Compare the values of h as obtained from the lumped capacitance and spatially-dependent analyses. Discuss.	6.35	
11	Search the texts and literature for a method of estimating h , or for other experimental data. How do your results compare to other measurements or estimates of h ?	6.35	

For alloys and other materials, we will consider h known and will compute unknown physical properties (k or c) of the alloys.

Lumped Capacitance Method

12	Determine or find the density for the alloys (stainless steel and brass) and plastics.	6.35	
13	Use the best known value of h from experimental data on pure solids from part A, and use the lumped capacitance method to determine c (the specific heat) for these materials. Based on what is known from Part A, is this a valid method to determine c ? If possible, obtain literature values for c and compare to your experimentally-determined values.	6.35	

Analysis with convection plus internal conduction

14	to determine k , the thermal conductivity of the alloys. Do this by determining C_1 and ζ_1 from linear regression of the data, and from ζ_1 determine the Biot number and hence k . Obtain θ from the data, using C_1 , ζ_1 and the Bi , compare.	6.35	
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Other points for analysis and discussion:

15	Are end effects important in the cylinder? For situations such as the cylinder, use the method of multidimensional effects to calculate the desired properties.	6.35	
16	Use correlations or other means to calculate the heat transfer coefficient. What could be done to vary h ? What can be done to decrease Bi ?	6.35	
17	Compare any values of c or k that you compute to literature (handbook) data.	6.35	
18	Determine the conductive and convective resistances to heat transfer. Which is dominant in each case?	6.35	
19	Determine the difference between the centerline thermocouple temperature and the water bath temperature. Make adjustments to correct any difference and explain the reasons for the difference.	6.35	
20	Explain the trend of the temperature versus time data.	6.35	
21	Explain what the plots of dimensionless time are showing.	6.35	

22	Explain the trends or characteristics of the different solids and materials.	6.35	
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