

TABLE OF CONTENTS

Introduction	INTRO - 1
Laboratory I: Conservation of Energy and Heat	I - 1
Problem #1: Temperature and Energy Transfer I	I - 2
Problem #2: Temperature and Energy Transfer II	I - 5
Problem #3: Identifying Unknown Metals	I - 8
Problem #4: The Composition of a Compound Object	I - 11
Problem #5: Latent Heat and the Mass of Ice	I - 13
Problem #6: Electrical Energy and Heat	I - 16
Table of Thermal Properties of Pure Metals	I - 19
Check Your Understanding	I - 21
Laboratory I Cover Sheet	I - 23
Laboratory II: Mechanical Oscillations	II - 1
Problem #1: Measuring Spring Constants	II - 2
Problem #2: Effective Spring Constants	II - 5
Problem #3: Oscillation Frequency with Two Springs	II - 8
Problem #4: Oscillation Frequency of an Extended System	II - 10
Problem #5: (Exploratory) Driven Oscillations	II - 13
Check Your Understanding	II - 15
Laboratory II Cover Sheet	II - 17
Laboratory III: Waves	III - 1
Problem #1: (Exploratory) Wave Speed	III - 2
Problem #2: Standing Wave Patterns	III - 5
Problem #3: Standing Wave Velocity	III - 8
Problem #4: Standing Waves	III - 10
Check Your Understanding	III - 13
Laboratory III Cover Sheet	III - 15
Laboratory IV: Electric Fields and Forces	IV - 1
Problem #1: (Exploratory) Electric Field Vectors	IV - 3
Problem #2: Electric Field from a Dipole	IV - 6
Problem #3: Electric Field from Parallel Charged Plates	IV - 9
Problem #4: Gravitational Force on the Electron	IV - 11
Problem #5: Deflection of an Electron Beam by Electric Force	IV - 14
Problem #6: Deflection of an Electron Beam and Velocity	IV - 17

Check Your Understanding	IV - 21
Laboratory IV Cover Sheet	IV - 23
Laboratory V: Electrical Circuits (resistors / capacitors)	V - 1
Problem #1: Basic Circuits	V - 3
Problem #2: More Complex Circuits	V - 6
Problem #3: (Exploratory) Short Circuits	V - 9
Problem #4: Resistors and Light Bulbs	V - 11
Problem #5: Circuit Analysis	V - 13
Problem #6: (Exploratory) Simple Circuits with Capacitors	V - 16
Problem #7: (Exploratory) Capacitance	V - 18
Problem #8: Circuits with Two Capacitors	V - 20
Check Your Understanding	V - 23
Laboratory V Cover Sheet	V - 25
Laboratory VI: Magnetic Fields and Forces	VI - 1
Problem #1: (Exploratory) Permanent Magnets	VI - 2
Problem #2: Current Carrying Wire	VI - 4
Problem #3: The Magnetic Field from a Current Carrying Wire	VI - 6
Problem #4: (Exploratory) Magnets and Moving Charges	VI - 8
Check Your Understanding	VI - 10
Laboratory VI Cover Sheet	VI - 11
Appendix A: Equipment	A - 1
Appendix B: Significant Figures	B - 1
Appendix C: Accuracy, Precision, and Uncertainty	C - 1
Appendix D: Graphing	D - 1
Appendix E: Software	E - 1
Appendix F: Sample Lab Report	F - 1

Acknowledgments

The authors would like to thank all the people who have contributed to the development of the exercises and appendices used in this laboratory manual:

Brian Batell	Vince Kuo
Jennifer Blue	Lance Lohstreter
Heather Brown	Michael Myhrom
Dave Demuth	Kevin Parendo
Andrew Ferstl	Jeremy Paschke
Tom Foster	Kevin Klapoetke
Charles Henderson	

And all of the teaching assistants who helped to find the 'bugs' in these instructions.

Kenneth & Patricia Heller

