

TABLE OF CONTENTS

Introduction	INTRO - 1
Laboratory 0: Determining an Equation for a Function from a Graph	0 - 1
Laboratory I: Forces and Equilibrium	I - 1
Problem #1: Springs and Equilibrium I	I - 2
Problem #2: Springs and Equilibrium II	I - 8
Problem #3: Forces and Liquids	I - 11
Problem #4: Leg Elevator	I - 14
Problem #5: Equilibrium in a Walkway	I - 17
Problem #6: Designing a Mobile	I - 20
Problem #7: Mechanical Arm	I - 22
Check Your Understanding	I - 24
Laboratory I Cover Sheet	I - 25
Laboratory II: Force and Conservation of Energy	II - 1
Problem #1: Constant Velocity Motion	II - 2
Problem #2: Falling	II - 7
Problem #3: Motion Down an Incline	II - 11
Problem #4: Normal Force and Frictional Force	II - 15
Problem #5: Velocity and Force	II - 18
Problem #6: Collisions	II - 22
Table of Coefficients of Friction	II - 25
Check Your Understanding	II - 26
Laboratory II Cover Sheet	II - 27
Laboratory III: Potential Energy	III - 1
Problem #1: Elastic and Gravitational Energy	III - 2
Problem #2: Using Potential Energy	III - 5
Problem #3: Pendulum	III - 6
Laboratory III Cover Sheet	III - 9
Laboratory IV: Oscillations	IV - 1
Problem #1: Measuring Spring Constants	IV - 2
Problem #2: Oscillation Frequency with Two Springs	IV - 5
Problem #3: Oscillation Frequency of an Extended System	IV - 8
Problem #4: Driven Oscillations	IV - 11
Problem #5: Simple Pendulum	IV - 14
Check Your Understanding	IV - 17
Laboratory IV Cover Sheet	IV - 19

Laboratory V: Predicting Non-repetitive Motion	V - 1
Problem #1: Motion in a Fluid	V - 2
Problem #2: Motion Up and Down an Incline	V - 4
Problem #3: Circular Motion	V - 8
Problem #4: Two-Dimensional Motion	V - 11
Problem #5: Bouncing	V - 14
Check Your Understanding	V - 17
Laboratory V Cover Sheet	V - 19
Laboratory VI: Energy and Thermal Processes	VI - 1
Problem #1: Power and Temperature Change	VI - 2
Problem #2: Specific Heat of Simple Objects	VI - 5
Problem #3: Specific Heat of Complex Objects	VI - 8
Problem #4: Mechanical Energy and Temperature Change	VI - 11
Problem #5: Energy Cycles and Efficiency	VI - 15
Table: Thermal Properties	VI - 19
Laboratory VI Cover Sheet	VI - 21
Appendix A: Equipment	A - 1
Appendix B: Significant Figures	B - 1
Appendix C: Accuracy, Precision and Uncertainty	C - 1
Appendix D: Video Analysis of Motion	D - 1
Appendix E: Sample Lab Report	E - 1
Appendix F: Simulation Programs	F - 1

Acknowledgments

Much of the work to develop this problem solving laboratory was supported by the University of Minnesota and the National Science Foundation. We would like to thank all the people who have contributed directly to the development of this laboratory manual:

Heather Brown	Andy Ferstl	Tom Foster
Kaiyan Gao	Charles Henderson	Ted Hodapp
Andrew Kunz	Vince Kuo	Laura McCullough
Michael Myhrom	Jeremy Paschke	Leon Steed
Hao Wang	Paul Barsic	Yaroslav Lutsyshyn
Zhaoliang Pan	Yousi Ma	Rhonald Lua
Tom Thaden-Koch	Yves Adjallah	Matthew Fritts
Tao Hu	Maribel Núñez V.	Ivan Gordeli

And all of the faculty and graduate students who helped to find the 'bugs' in these instructions.

Kenneth & Patricia Heller

