

Table of Contents

Chapter 1 About Science

Making Hypotheses	7
Pinhole Formation	8

PART ONE MECHANICS

Chapter 2 Newton's First Law of Motion—Inertia

Static Equilibrium	9
The Equilibrium Rule: $\Sigma F = 0$	10
Vectors and Equilibrium	11

Chapter 3 Linear Motion

Free Fall Speed	13
Acceleration of Free Fall	14
Hang Time	15
Non-Accelerated Motion	16
Vectors and the Parallelogram Rule	17
Velocity Vectors and Components	18

Chapter 4 Newton's Second Law of Motion

Force and Velocity Vectors	19
Force Vectors and the Parallelogram Rule	20
Mass and Weight	21
Converting Mass to Weight	22
Racing Day with $a = F/m$	23
Dropping Masses and Accelerating Cart	24
Force and Acceleration	27
Friction	29
Falling and Air Resistance	30

Chapter 5 Newton's Third Law of Motion

Action and Reaction Pairs	31
Interactions	32
Force-Vector Diagrams	33
More on Vectors	34

Appendix D More About Vectors

Vectors and Sailboats	35
-----------------------	----

Chapter 6 Momentum

Changing Momentum	37
Systems	39

Chapter 7 Energy

Work and Energy	41
Conservation of Energy	43
Momentum and Energy	45
Energy and Momentum	46

Chapter 8 Rotational Motion

Torques	47
Torques and Rotation	49
Acceleration and Circular Motion	50
The Flying Pig	51
Banked Airplanes	52
Banked Track	53
Leaning	54
Simulated Gravity and Frames of Reference	55

Chapter 9 Gravity

Inverse-Square Law and Weight	57
Our Ocean Tides	59

Chapter 10 Projectile and Satellite Motion

Independence of Horizontal and Vertical Components of Motion	61
Tossed Ball	63
Satellite in Circular Orbit	65
Satellite in Elliptical Orbit	66

Mechanics Overview—Chapters 1 to 10

PART TWO PROPERTIES OF MATTER

Chapter 11 The Atomic Nature of Matter

Atoms and Atomic Nuclei	69
Subatomic Particles	70

Chapter 12 Solids

Scaling	71
Scaling Circles	72

Chapter 13 Liquids

Archimedes' Principle I	73
Archimedes' Principle II	75

Chapter 14 Gases

Gas Pressure	77
--------------	----

PART THREE HEAT

Chapter 15 Temperature, Heat, and Expansion

Measuring Temperatures	79
Thermal Expansion	80

Chapter 16 Heat Transfer

Transmission of Heat	81
----------------------	----

Chapter 17 Change of Phase

Ice, Water, and Steam	83
Evaporation	85
Our Earth's Hot Interior	86

Chapter 18 Thermodynamics

Absolute Zero	87
---------------	----

PART FOUR SOUND**Chapter 19 Vibrations and Waves**

Vibration and Wave Fundamentals	89
Shock Waves	91

Chapter 20 Sound

Wave Superposition	93
--------------------	----

**PART FIVE ELECTRICITY
AND MAGNETISM****Chapter 22 Electrostatics**

Coulomb's Law	95
Static Charge	96
Electric Potential	97

Chapter 23 Electric Current

Flow of Charge	99
Ohm's Law	100
Electric Power	101
Circuit Happenings	102
Series Circuits	105
Parallel Circuits	107
Circuit Resistance	108
Electric Power in Circuits	109

Chapter 24 Magnetism

Magnetic Fundamentals	111
-----------------------	-----

**Chapter 25 Electromagnetic
Induction**

Faraday's Law	113
Transformers	115

PART SIX LIGHT**Chapter 26 Properties of Light**

Speed, Wavelength, and Frequency	117
----------------------------------	-----

Chapter 27 Color

Color Addition	119
----------------	-----

Chapter 28 Reflection and Refraction

Pool Room Optics	121
Reflection	123
Reflected Views	125
More Reflection	126
Refraction	127
More Refraction	129
Lenses	131

Chapter 29 Light Waves

Diffraction and Interference	133
Polarization	135

**PART SEVEN ATOMIC AND
NUCLEAR PHYSICS****Chapters 31 and 32 Light Quanta
and The Atom and The Quantum**

Light Quanta	137
--------------	-----

**Chapter 33 The Atomic Nucleus
and Radioactivity**

Radioactivity	139
Nuclear Reactions	140
Natural Transmutation	141

**Chapter 34 Nuclear Fission
and Fusion**

Nuclear Reactions	143
-------------------	-----

PART EIGHT RELATIVITY**Chapter 35 Special Theory of Relativity**

Time Dilation	145
---------------	-----

Answers to Practice Pages

Chapters 1–36	146
---------------	-----