

**Principles of
Physics**

FREDERICK J. BUECHE

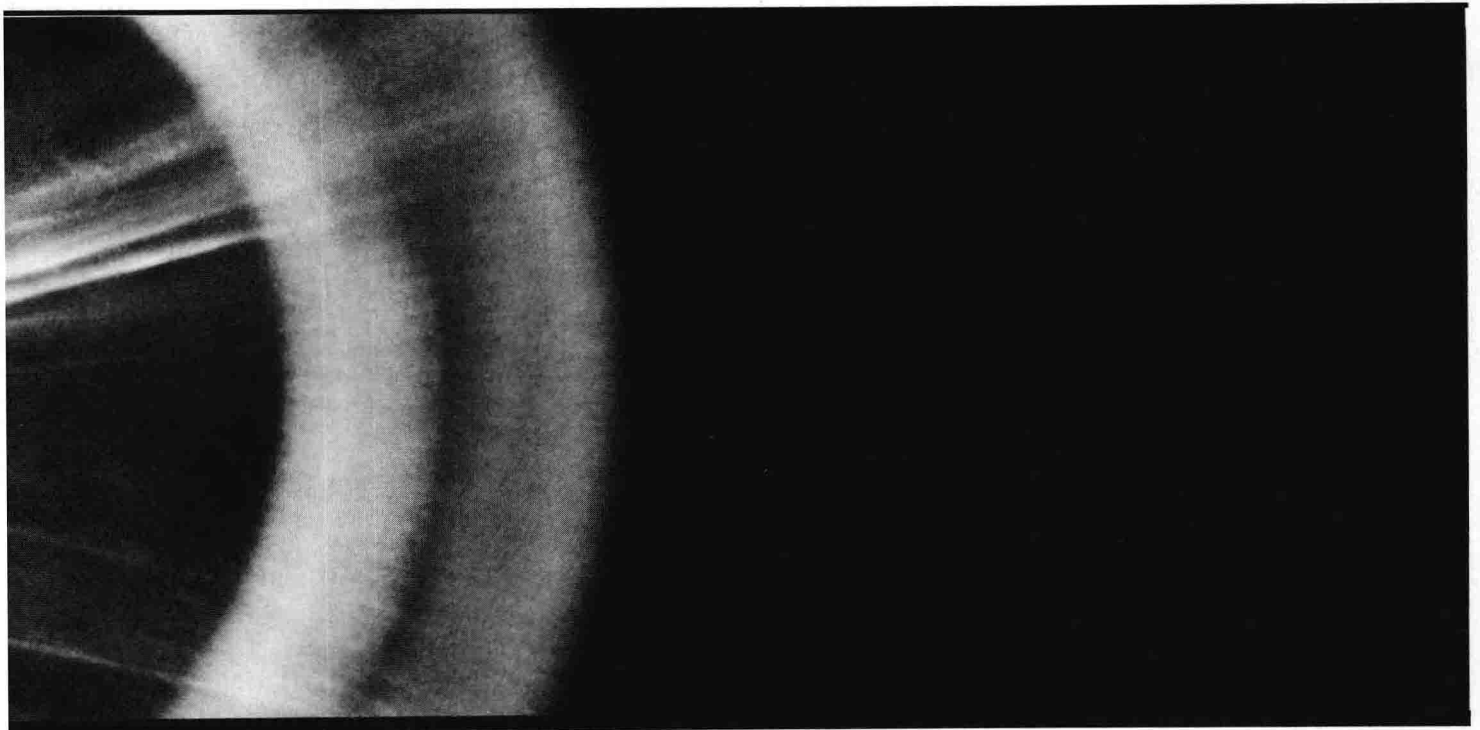
FIFTH EDITION

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Principles of Physics

F. BUECHE

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Principles of Physics

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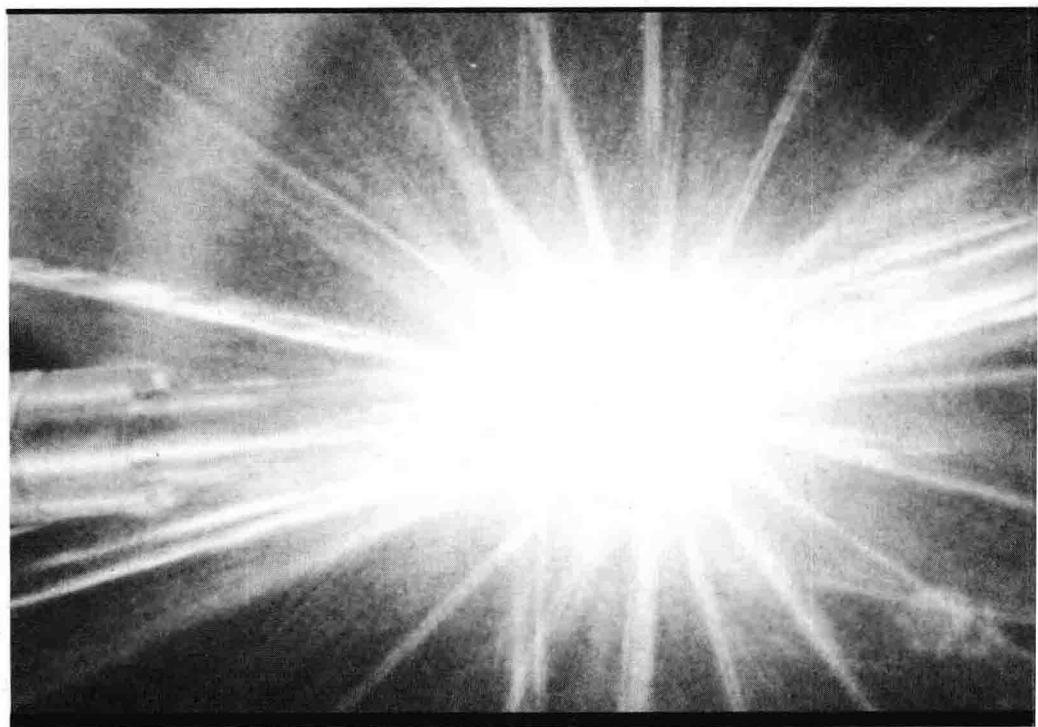
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Preface

THIS text is designed for the noncalculus physics course taken by those who intend to pursue careers in science and its application. It can also be used profitably by intelligent nonscientists who desire a better understanding of the world in which we live. Although mathematics through simple algebra and trigonometry is used, the trigonometry required is taught in the text and the algebra as presented is not difficult. I believe firmly—and experience confirms—that the average college student is capable of mastering the material in this book without undue difficulty.

One of the major guidelines I have followed in preparing this text is that, because time is so limited, the principles of physics must receive overriding emphasis. Although relatively few in number, these principles form the framework on which we base our understanding of nature. It is important that students understand how each facet of their study is related to these principles. In that way, they see that many seemingly unrelated facts are simply different glimpses of the same fundamental concept. Physics thus becomes an understandable, related whole rather than a collection of individual facts and formulas to be memorized.

Because the principles of physics permeate the world around us, we can elicit many of them from careful observation of familiar phenomena. I try to present each fundamental principle by drawing upon the wealth of observational data each student already possesses. When students are led in this way, it is easy for them to achieve first a qualitative and then a quantitative appreciation of the principle. Although many physical concepts are quite complex until they are well understood, the skillful teacher—and that is what this textbook tries to be—can lead the student to understanding while bypassing the pitfalls that seem to obscure the concept.

No concept is completely understood until one can use it to solve problems that require both qualitative and quantitative reasoning. This text provides a multitude of **worked examples** to illustrate quantitative applications. In addition, the **questions and guesstimates** at the end of each chapter test the students' ability to reason out the meaning of challenging situations, and the end-of-chapter **problems** provide ample opportunity for quantitative practice.

You will notice that the difficulty level of each problem is indicated, with the more difficult problems being preceded by a single or a double solid square. However, the particular section to which the problem applies is not listed, although this is done in the instructor's manual. I do this for two reasons: (1) many problems require ideas from several sections, and (2) a major part of problem solving is to determine which concept to apply. I wish my students to be able to furnish this aspect of problem analysis, and I assume you wish the same for your students.

The solution methods for all problems are given in a solutions manual prepared by Joseph J. Kepes. In addition, he has prepared a workbook that gives the student additional practice.

One of the major difficulties students have in learning physics is the result of our trying to cover too much in too little time. By emphasizing principles, I have been able to divide the text into only 28 chapters, including four on modern physics. This amounts to about one chapter a week for the traditional two-semester course. If even this proves to be too formidable a menu, further abbreviations that can be instituted are pointed out in the instructor's manual.

Despite my emphasis on principles, you will find many **applications** and interesting **sidelights** scattered throughout the text. The applications are carefully screened for relevance to the principles being taught; care is taken that the principles stand out clearly and do not become lost among the extraneous material. The **special notes** interjected throughout the text are intended to extend the students' horizons, provide interesting sidelights to the material being studied, and encourage an appreciation of the historical and cultural aspects of physics. I have noticed that students often flip through the text to read these notes, which are conveniently set apart from the text proper. Students seem to relish these interesting, often self-contained excursions into optional material.

New to the Fifth Edition

In response to extensive surveys and reviews, numerous changes in organization, coverage, and presentation have been made in this new edition of *Principles of Physics*. If you used the fourth edition and wanted some changes, look for them here; they probably have been made. A cursory examination will show that the figures and the use of color have been improved greatly. Notice how the most important statements and equations are enhanced by color and by their positioning on the page. Further emphasis is achieved by the judicious use of boldface and italic type. Many of the end-of-chapter problems are new, and most of the others use new numbers. **Minimum learning goals** serve as a summary for each chapter. They have the advantage of requiring the active participation of the student for their use, thus serving as a self-test.

One change deserves special comment: statics now precedes linear motion. Many experienced teachers have long recognized the great difficulty students experience with the topic of motion. Recent educational research confirms their observations. We have therefore returned to the "old-fashioned" format so dear to the hearts of many experienced teachers: simple statics is studied first and then linear motion is introduced, with particular care being taken to avoid misunderstandings and to remove mistaken concepts. On a more practical level, motion problems tend to

encourage memorization, something we wish to deemphasize. By starting with statics, we can easily show the students that success in physics is *not* achieved through memorization.

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Contents in brief

- 1 Vectors and their use 4
- 2 Static equilibrium 21
- 3 Uniformly accelerated motion 44
- 4 Newton's laws 69
- 5 Work and energy 94
- 6 Linear momentum 118
- 7 Motion in a circle 137
- 8 Rotational work, energy, and momentum 160
- 9 Mechanical properties of matter 177
- 10 Gases and the kinetic theory 203
- 11 Thermal properties of matter 223
- 12 Thermodynamics 249
- 13 Vibration and waves 278
- 14 Sound 302
- 15 Electric forces and fields 326
- 16 Electric potential 349
- 17 DC circuits 373
- 18 Magnetism 406
- 19 Electromagnetic induction 435
- 20 Alternating currents and electronics 462
- 21 Electromagnetic waves 483
- 22 The properties of light 504
- 23 Optical devices 535
- 24 Interference and diffraction 555
- 25 Three revolutionary concepts 582
- 26 Energy levels and spectra 621
- 27 The atomic nucleus 651
- 28 The physics of the very large and very small 691

Contents

Preface xv

Introduction 1

1 Vectors and their use 4

- 1.1 Vector and scalar quantities 4
- 1.2 Vector addition 5
- 1.3 Graphical addition of vectors 6
- 1.4 Rectangular components of vectors 7
- 1.5 Trigonometric addition of vectors 9
- 1.6 Forces as vector quantities 11
- 1.7 Subtraction of vector quantities 13
- **SPECIAL NOTE: *Sailing into the wind*** 14
- 1.8 Metric prefixes and scientific notation 14
- 1.9 Algebra involving scientific notation 16
- Minimum learning goals 17
- Questions and guesstimates 18
- Problems 18

2 Static equilibrium 21

- 2.1 Objects in equilibrium 21
- 2.2 The first condition for equilibrium 23

- 2.3 Solving problems in statics 25
- 2.4 Torque 27
- 2.5 The second condition for equilibrium 29
- 2.6 The center of gravity 30
- 2.7 The position of the pivot is arbitrary 31
- **SPECIAL NOTE: *Mobiles*** 32
- 2.8 Back injury from lifting 37
- 2.9 Why objects tip over 37
- **SPECIAL NOTE: *Architectural arches*** 36
- Minimum learning goals 39
- Questions and guesstimates 39
- Problems 39

3 Uniformly accelerated motion 44

- 3.1 Speed 44
- 3.2 Average velocity 45
- 3.3 Instantaneous velocity 46
- 3.4 One-dimensional motion 47
- 3.5 Acceleration 50

- 3.6 Uniformly accelerated linear motion 51
- 3.7 Two derived equations for uniformly accelerated motion 54
- 3.8 Conversion of units 56
- 3.9 Freely falling bodies 57

▪ SPECIAL NOTE: *Theories of free fall* 58

- 3.10 Projectile motion 62

▪ SPECIAL NOTE: *Galileo Galilei* 60

Minimum learning goals 64

Questions and guesstimates 65

Problems 65

4 Newton's laws 69

- 4.1 The discovery of physical laws 69

- 4.2 Newton's first law of motion 71

▪ SPECIAL NOTE: *Isaac Newton* 70

- 4.3 Inertia and mass 72

- 4.4 Action and reaction: the third law 72

- 4.5 The SI system of units 73

- 4.6 Newton's second law 75

▪ SPECIAL NOTE: *The methods of science* 76

- 4.7 Mass and its relation to weight 78

- 4.8 Friction forces 79

- 4.9 Application of Newton's second law 81

- 4.10 Weight and weightlessness 83

Minimum learning goals 89

Questions and guesstimates 89

Problems 90

5 Work and energy 94

- 5.1 The definition of work 94

- 5.2 Power 97

- 5.3 Kinetic energy 98

- 5.4 The work-energy theorem 100

- 5.5 Gravitational potential energy 101

- 5.6 The gravitational force is conservative 102

- 5.7 The interconversion of kinetic and potential energy 104

- 5.8 Other forms of energy 104

- 5.9 The law of conservation of energy 105

- 5.10 Machines 110

▪ SPECIAL NOTE: *Perpetual motion machines* 112

Minimum learning goals 113

Questions and guesstimates 114

Problems 114

6 Linear momentum 118

- 6.1 The concept of linear momentum 118

- 6.2 Newton's second law restated 119

- 6.3 Conservation of linear momentum 121

- 6.4 Elastic and inelastic collisions 124

▪ SPECIAL NOTE: *Momentum in particle physics* 124

- 6.5 Rockets and jet propulsion 126

- 6.6 Momentum components 127

▪ SPECIAL NOTE: *The long-ball hitter* 128

- 6.7 The pressure of an ideal gas 129

Minimum learning goals 132

Questions and guesstimates 132

Problems 133

7 Motion in a circle 137

- 7.1 Angular displacement θ 137

- 7.2 Angular velocity ω 138

- 7.3 Angular acceleration α 139

- 7.4 Angular motion equations 140

- 7.5 Tangential quantities 141

- 7.6 Centripetal acceleration 144

- 7.7 Centripetal force 146

- 7.8 A common misconception 148

- 7.9 Newton's law of gravitation 149

- 7.10 The gravitational force and weight 151

- 7.11 Orbital motion 152

- 7.12 Weightlessness 153

Minimum learning goals 155

Questions and guesstimates 156

Problems 156

8 Rotational work, energy, and momentum 160

- 8.1 Rotational work and kinetic energy 160

- 8.2 Rotational inertia 162

- 8.3 Combined rotation and translation 167

- 8.4 Angular momentum 169

▪ SPECIAL NOTE: *How cats land feet first* 172

Minimum learning goals 173

Questions and guesstimates 173

Problems 173

9 Mechanical properties of matter 177

- 9.1 Characterization of materials 177
- 9.2 Density 179
- 9.3 Hooke's law; modulus 180
- 9.4 Pressure in fluids 184
- 9.5 Archimedes' principle; buoyancy 187
- 9.6 Viscosity 189
- 9.7 Bernoulli's equation 191
- 9.8 Laminar versus turbulent flow 193
- 9.9 Viscous drag; Stokes' law 194
- 9.10 Terminal velocity 196

▪ **SPECIAL NOTE:** *The centrifuge* 198

- 9.11 Blood-pressure measurement 197

Minimum learning goals 199

Questions and guesstimates 199

Problems 200

10 Gases and the kinetic theory 203

- 10.1 Barometric pressure 203
- 10.2 Thermometers and temperature scales 207

▪ **SPECIAL NOTE:** *Soft drinks and siphons* 206

- 10.3 The mole and Avogadro's number 209
- 10.4 The ideal gas law 210
- 10.5 Using the gas law 212
- 10.6 The molecular basis for the gas law 215

▪ **SPECIAL NOTE:** *Atoms: a historic struggle* 216

- 10.7 Distribution of molecular speeds 217

Minimum learning goals 219

Questions and guesstimates 219

Problems 220

11 Thermal properties of matter 223

- 11.1 The concept of heat 223
- 11.2 Thermal energy 224
- 11.3 Heat units 225
- 11.4 Specific heat capacity 226

▪ **SPECIAL NOTE:** *James Prescott Joule* 226

- 11.5 Vaporization and boiling 228
- 11.6 Heat of fusion and melting 229

- 11.7 Calorimetry 230
- 11.8 Thermal expansion 233
- 11.9 Transfer of heat: conduction 236
- 11.10 Transfer of heat: convection 238
- 11.11 Transfer of heat: radiation 239
- 11.12 Home insulation 241

▪ **SPECIAL NOTE:** *Our fragile climate* 240

- 11.13 Humidity 243

Minimum learning goals 244

Questions and guesstimates 244

Problems 245

12 Thermodynamics 249

- 12.1 State variables 249
- 12.2 The first law of thermodynamics 250
- 12.3 The work done by a system 252
- 12.4 Specific heats of ideal gases 254
- 12.5 Typical processes in gases 257
- 12.6 Nature and time's arrow 260
- 12.7 Order versus disorder 261
- 12.8 Entropy 263
- 12.9 Heat engines 265
- 12.10 The absolute temperature scale 269

▪ **SPECIAL NOTE:** *Food, fat, and work* 268

- 12.11 Refrigerators, air conditioners, and heat pumps 270

- 12.12 The heat death of the universe 273

Minimum learning goals 274

Questions and guesstimates 274

Problems 275

13 Vibration and waves 278

- 13.1 Periodic motion 278
- 13.2 Energy in a Hooke's law spring 280
- 13.3 Simple harmonic motion 283
- 13.4 Frequency of vibration in simple harmonic motion 284
- 13.5 Sinusoidal motion 285
- 13.6 The simple pendulum 286
- 13.7 Forced vibrations 287
- 13.8 Wave terminology 288
- 13.9 Reflection of a wave 290
- 13.10 Wave resonance 292
- 13.11 Transverse waves 293

- 13.12 Longitudinal waves 294
- 13.13 Standing compressional waves on a spring 295
- 13.14 Compressional waves on a bar 296
- Minimum learning goals 297
- Questions and guesstimates 298
- Problems 298

14 Sound 302

- 14.1 The origin of sound 302
- 14.2 Sound waves in air 303
- 14.3 The speed of sound 304
- 14.4 Intensity and intensity level 305
- 14.5 The frequency response of the ear 307
- 14.6 Sound pitch and quality 308
- 14.7 Interference of sound waves 310
- SPECIAL NOTE: *The acoustics of large rooms* 312
- 14.8 Beats 313
- 14.9 Resonance of air columns 315
- 14.10 The Doppler effect 316
- SPECIAL NOTE: *The speeds of blood and baseballs* 320
- Minimum learning goals 322
- Questions and guesstimates 323
- Problems 323

15 Electric forces and fields 326

- 15.1 Atoms as the source of charge 326
- 15.2 Forces between charges 327
- 15.3 Insulators and conductors 328
- 15.4 The electroscope 328
- 15.5 Charging by conduction and by induction 329
- 15.6 Faraday's ice-pail experiment 330
- 15.7 Conservation of charge 331
- 15.8 Coulomb's law 332
- SPECIAL NOTE: *Hunting quarks* 332
- 15.9 The electric field 337
- 15.10 The electric field of a point charge 339
- 15.11 The electric field in various systems 341
- 15.12 Parallel metal plates 344
- Minimum learning goals 345
- Questions and guesstimates 345
- Problems 346

16 Electric potential 349

- 16.1 Electrical potential energy 349
- 16.2 Potential difference 351
- 16.3 Equipotentials 352
- 16.4 Batteries as sources of energy 354
- 16.5 The electronvolt energy unit 356
- 16.6 Absolute potentials 357
- 16.7 Capacitors 361
- SPECIAL NOTE: *Millikan's oil-drop experiment* 360
- 16.8 Dielectrics 363
- 16.9 The effects of dielectrics 367
- 16.10 The energy stored in a capacitor 368
- 16.11 The energy stored in an electric field 368
- Minimum learning goals 369
- Questions and guesstimates 370
- Problems 371

17 Direct-current circuits 373

- 17.1 Electric current 373
- 17.2 A simple electric circuit 374
- 17.3 Ohm's law 376
- 17.4 Resistivity and its temperature dependence 377
- SPECIAL NOTE: *Superconductors* 380
- 17.5 Power and electric heating 379
- 17.6 Kirchhoff's point rule 383
- 17.7 Kirchhoff's loop rule 384
- 17.8 Resistors in series and in parallel 387
- 17.9 Solving circuit problems 391
- 17.10 Ammeters and voltmeters 396
- 17.11 House circuits 396
- 17.12 Electrical safety 398
- 17.13 The emf and terminal potential of a battery 399
- Minimum learning goals 401
- Questions and guesstimates 402
- Problems 403

18 Magnetism 406

- 18.1 Magnetic field plotting 406
- 18.2 The magnetic field of an electric current 408
- 18.3 The force on a current in a magnetic field 409

- 18.4 An extension of the right-hand rule 412
- 18.5 Forces on moving charges 412
- 18.6 Particle motion in a magnetic field 414
- 18.7 The Hall effect 416
- 18.8 The earth's magnetic field 417
- 18.9 Magnetic fields of a current 418
- 18.10 The definition of the ampere unit 421

▪ SPECIAL NOTE: *Geomagnetism and plate tectonics* 420

- 18.11 Magnetic materials 422
- 18.12 The torque on a current loop 425
- 18.13 Moving-coil meters 428
- 18.14 Ammeters 429
- 18.15 Voltmeters 430
- Minimum learning goals 431
- Questions and guesstimates 431
- Problems 431

19 Electromagnetic induction 435

- 19.1 Induced emf 435
- 19.2 Magnetic flux 437
- 19.3 Faraday's law 439
- 19.4 Mutual induction 441
- 19.5 Self-inductance 442

▪ SPECIAL NOTE: *Michael Faraday* 442

- 19.6 Inductance-resistance circuits 444
- 19.7 The energy in a magnetic field 445
- 19.8 Motional emf 446
- 19.9 AC generators 448
- 19.10 Motors 452
- 19.11 Transformers 454

▪ SPECIAL NOTE: *Tape recorders* 454

- 19.12 Eddy currents 456
- Minimum learning goals 457
- Questions and guesstimates 457
- Problems 458

20 Alternating currents 462

- 20.1 Charging and discharging a capacitor 462
- 20.2 AC quantities; RMS values 464
- 20.3 Resistance circuits 466
- 20.4 Capacitance circuits 466
- 20.5 Inductance circuits 469

- 20.6 Combined *LRC* circuits 470
- 20.7 Electrical resonance 474
- 20.8 Rectification of currents 477
- Minimum learning goals 479
- Questions and guesstimates 479
- Problems 480

21 Electromagnetic waves 483

- 21.1 The generation of em waves 483
- 21.2 Types of electromagnetic waves 487
- 21.3 Reception of radio waves 489
- 21.4 The speed of em waves 490
- 21.5 Maxwell's equations 493

▪ SPECIAL NOTE: *James Clerk Maxwell* 494

- 21.6 The energy carried by em waves 495

▪ SPECIAL NOTE: *Magnetic monopoles* 496

- 21.7 The inverse-square law for radiation 498
- 21.8 The definition of electrical units 500
- Minimum learning goals 501
- Questions and guesstimates 501
- Problems 502

22 The properties of light 504

- 22.1 The concept of light 504
- 22.2 The speed of light 506
- 22.3 The reflection of light 507
- 22.4 Plane mirrors 509
- 22.5 The focus of a concave spherical mirror 510
- 22.6 Three reflected rays and image formation 511
- 22.7 The mirror equation 513
- 22.8 Convex mirrors 516
- 22.9 The refraction of light: Snell's law 519
- 22.10 Total internal reflection 522
- 22.11 Lenses 524
- 22.12 Ray diagrams for thin lenses 525
- 22.13 The thin-lens formula 527
- 22.14 Combinations of lenses 529
- Minimum learning goals 531
- Questions and guesstimates 531
- Problems 532

23 Optical devices 535

- 23.1 The eye 535
- 23.2 The simple camera 538
- 23.3 Lenses in close combination: diopter units 539
- 23.4 The magnifying glass 540
- 23.5 The compound microscope 543
- 23.6 The astronomical telescope 544
- 23.7 The binocular 545

■ SPECIAL NOTE: *Radio astronomy* 546

- 23.8 The prism spectrometer 546
- 23.9 Polarized light 548
- Minimum learning goals 552
- Questions and guesstimates 552
- Problems 553

24 Interference and diffraction 555

- 24.1 Huygens' principle and diffraction 555
- 24.2 Interference 556
- 24.3 Young's double-slit experiment 560
- 24.4 Coherent waves and sources 562

■ SPECIAL NOTE: *Thomas Young* 562

- 24.5 Interference in thin films 563
- 24.6 Equivalent optical path length 565
- 24.7 The diffraction grating 566
- 24.8 Diffraction by a single slit 570
- 24.9 Diffraction and the limits of resolution 571
- SPECIAL NOTE: *Picturing the interior of the human body* 574
- 24.10 The diffraction of x-rays by crystals 576
- Minimum learning goals 578
- Questions and guesstimates 578
- Problems 579

25 Three revolutionary concepts 582

- 25.1 The postulates of relativity 583
- 25.2 The speed of light as a limiting speed 584
- 25.3 Simultaneity 585
- SPECIAL NOTE: *Albert Einstein* 588
- 25.4 Moving clocks run too slowly 586
- 25.5 Relativistic length contraction 591

- 25.6 The relativistic mass-energy relation 593
- 25.7 Planck's discovery 595
- 25.8 Einstein's use of Planck's concept 598

■ SPECIAL NOTE: *Max Planck* 598

- 25.9 The Compton effect 603
- 25.10 The momentum of the photon 605
- 25.11 The de Broglie wavelength 605
- 25.12 Wave mechanics versus classical mechanics 608
- 25.13 Resonance of de Broglie waves: stationary states 610
- 25.14 The uncertainty principle 614
- Minimum learning goals 616
- Questions and guesstimates 616
- Problems 617

26 Energy levels and spectra 621

- 26.1 The modern history of atoms 621
- 26.2 The semiclassical hydrogen atom 624
- 26.3 Hydrogen energy levels 626

■ SPECIAL NOTE: *Niels Bohr* 628

- 26.4 Light emission from hydrogen 629
- 26.5 The absorption spectrum of hydrogen 633
- 26.6 The wave theory of the atom 635
- 26.7 Quantum numbers and the Pauli exclusion principle 637
- 26.8 The periodic table 639
- 26.9 X-rays and the spectra of multielectron atoms 640
- SPECIAL NOTE: *The discovery of x-rays* 644
- 26.10 Laser light 643
- Minimum learning goals 647
- Questions and guesstimates 648
- Problems 648

27 The atomic nucleus 651

- 27.1 Atomic number and mass number 651
- 27.2 Nuclear masses; isotopes 652
- 27.3 Nuclear size and density 654
- 27.4 Nuclear binding energy 656
- 27.5 Radioactivity 659
- 27.6 Exponential decay 662
- 27.7 Emissions from naturally radioactive nuclei 664

■ SPECIAL NOTE: *The discovery of radioactivity* 666

27.8	Nuclear reactions	667
27.9	Natural radioactive series	669
27.10	Interactions of radiation with matter	671
27.11	The detection of radiation	672
27.12	Radiation units	673
27.13	Radiation damage	675
27.14	Medical uses of radioactivity	676
27.15	Radioactive dating	677
27.16	The fission reaction	677
27.17	Nuclear reactors	680
27.18	Nuclear fusion	682
27.19	Nuclear models	684
	Minimum learning goals	686
	Questions and guesstimates	687
	Problems	687

28 The physics of the very large and very small 691

28.1	The ancient history of particle physics	691
28.2	Particle accelerators	692
28.3	Particles within particles: quarks	694

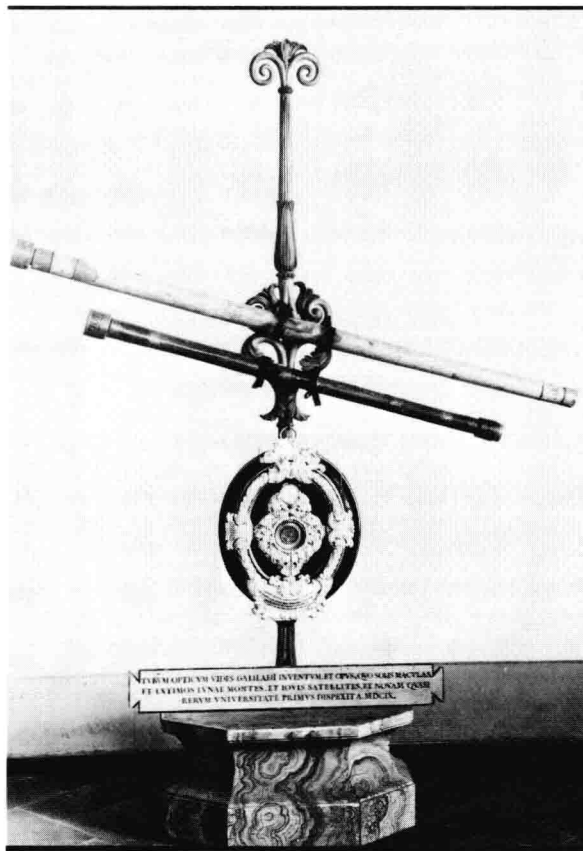
28.4	Leptons versus hadrons	697
28.5	Fundamental forces	699
28.6	The force between quarks: gluons	700
28.7	The primordial fireball	702
28.8	Stellar evolution	704
28.9	The expanding universe	706
28.10	The future	708
	Minimum learning goals	709
	Questions and guesstimates	709
	Problems	709

Appendixes

1	The periodic table of the elements	711
2	An abbreviated table of isotopes	712
3	A mathematics review	716
4	Trigonometric functions	721
5	Answers to odd-numbered problems	722

Index 727

Introduction



AS you begin your study of physics, there are probably several questions in your mind concerning the nature of this course and the field of physics in general. Let us therefore take time at the outset to make a few general comments you may find valuable.

What is physics?

We cannot give a one-sentence answer that does justice to this question. Some typical short answers are:

- 1 Physics is the study of the laws of nature and their application to nonliving things.
- 2 Physics is the science of matter and energy and of the relations between them.
- 3 Physics is the most basic of all sciences. It deals with the structure and behavior of matter.
- 4 Physics is the body of knowledge gained from the study of natural phenomena.
- 5 Physics is what physicists do.

All of these describe the field of physics, but the last answer is perhaps more informative than the others. So let us examine what physicists do.