B. M. YAVORSKY AND A. A. DETLAF

A Modern Handbook of PHYSICS

Translated from the Russian by
NICHOLAS WEINSTEIN

Б. М. ЯВОРСКИЙ, А. А. ДЕТЛАФ

СПРАВОЧНИК ПО ФИЗИКЕ

Москва «Наука»

B. M. YAVORSKY AND A. A. DETLAF

A Modern Handbook Of PHYSICS

Translated from the Russian by
NICHOLAS WEINSTEIN

Mir Publishers Moscow

First published 1982
Revised from the 1980 Russian edition

© Издательство «Наука».
Главная редакция физико-математической литературы,
1982

© English translation, Mir Publishers, 1982

此为试读,需要完整PDF请访问: www.ertongbook.com

Contents

Preface 16

PART ONE MECHANICS

CHAPTER 1 KINEMATICS

1.1 Mechanical Motion. The Subject Matter of Mechanics 19
1.2 Frames of Reference. Path, Path Length and Displacement Vector of a Particle 21
1.3 Velocity 24
1.4 Acceleration 27
1.5 Translational and Rotary Motion of a Rigid Body 29

CHAPTER 2 NEWTON'S LAWS

2.1 Newton's First Law. Inertial Frames of Reference 34
2.2 Force 35
2.3 Mass. Momentum 38
2.4 Newton's Second Law 40
2.5 Newton's Third Law. Motion of the Centre of Mass 42
2.6 Motion of a Body of Variable Mass 44
2.7 Law of Conservation of Momentum 46
2.8 Galilean Transformations. Mechanical Principle of Relativity 48

CHAPTER 3 WORK AND MECHANICAL ENERGY

3.1 Energy, Work and Power 51
3.2 Kinetic Energy 56

3.3 Potential Energy 59
3.4 Law of Conservation of Mechanical Energy 63
3.5 Perfectly Elastic and Inelastic Collisions 66

CHAPTER 4 DYNAMICS OF ROTARY MOTION

4.1 Moment of Force and Angular Momentum 70
4.2 Moment of Inertia 74
4.3 The Fundamental Law in the Dynamics of Rotary Motion 77
4.4 Law of Conservation of Angular Momentum 81

CHAPTER 5 FUNDAMENTALS OF THE SPECIAL THEORY OF RELATIVITY

5.1 Postulates of the Special Theory of Relativity 84
5.2 Simultaneity of Events. Synchronization of Clocks 87
5.3 Lorentz's Transformations 89
5.4 Relativity of Lengths and Time Intervals. Time Interval Between Two Events 90
5.5 Transformation of Velocities and Accelerations in Relativistic Kinematics 96
5.6 Basic Law of Relativistic Dynamics 99
5.7 Mass-Energy Relation 101

CHAPTER 6 GRAVITATION

6.1 Law of Universal Gravitation 104
6.2 Gravitational Field 107
6.3 Kepler's Laws. Space Velocities 112

CHAPTER 7 MOTION IN NONINERTIAL FRAMES OF REFERENCE

7.1 Kinematics of Relative Motion 115
7.2 Inertial Forces 117
7.3 Relative Motion in a Frame of Reference Fixed to the Earth. Gravity Force and Weight of a Body 119
7.4 Principle of Equivalence 123

PART TWO FUNDAMENTALS OF MOLECULAR PHYSICS AND THERMODYNAMICS

CHAPTER 8 IDEAL GASES

8.1 Subject Matter of Molecular Physics. Thermal Motion 126
8.2 Statistical and Thermodynamic Methods of Investigation 127
8.3 Thermodynamic Variables. Equations of State. Thermodynamic Processes 129
8.4 Equation of State of an Ideal Gas 132

CHAPTER 9 FIRST LAW OF THERMODYNAMICS

9.1 Total and Internal Energy of a System 134
9.2 Heat and Work 137
9.3 First Law of Thermodynamics 140
9.4 Graphical Representation of Thermodynamic Processes and Work 141
9.5 Heat Capacity of Matter. Applying the First Law of Thermodynamics to Isoprocesses in an Ideal Gas 143

CHAPTER 10 KINETIC THEORY OF GASES

10.1 Certain Information on Classical Statistical Physics 151
10.2 Basic Equation of the Kinetic Theory of Gases 152
10.3 Maxwell's Molecular Velocity and Energy Distribution Law (Maxwell's Distribution Law) 154
10.4 Particle Distribution in a Potential Force Field (Boltzmann Distribution) 159
10.5 Mean Free Path of Molecules 161
10.6 Principle of the Equipartition of Energy. Internal Energy of an Ideal Gas 162
10.7 Heat Capacity of Monoatomic, Diatomic and Polyatomic Gases 165
10.8 Transport Phenomena in Gases 170
10.9 Properties of Rarified Gases 175

CHAPTER 11 SECOND LAW OF THERMODYNAMICS

11.1 Cycles. The Carnot Cycle 177
11.2 Reversible and Irreversible Processes 181

11.3 Second Law of Thermodynamics 182
11.4 Entropy and Free Energy 185
11.5 Statistical Interpretation of the Second Law of Thermodynamics 188
11.6 Fluctuations 189
11.7 Brownian Movement 192
11.8 Third Law of Thermodynamics 193

CHAPTER 12 REAL GASES AND VAPOURS

12.1 Forces of Intermolecular Interaction 194
12.2 Van der Waals Equation of State 200
12.3 Isothermals of Real Gases. Phase Transitions 202
12.4 Superfluidity of Helium 205

CHAPTER 13 LIQUIDS

13.1 Certain Properties of Liquids 207
13.2 Frenkel's Hole Theory of the Liquid State 208
13.3 Diffusion and Viscosity Phenomena in Liquids 210
13.4 Surface Tension of Liquids 211
13.5 Wetting and Capillary Phenomena 213
13.6 Vaporization and Boiling of Liquids 217

PART THREE ELECTRODYNAMICS

CHAPTER 14 ELECTRIC CHARGES. COULOMB'S LAW

14.1 Introduction 220
14.2 Coulomb's Law 221

CHAPTER 15 ELECTRIC FIELD STRENGTH AND DISPLACEMENT

15.1 Electric Field. Field Strength 224
15.2 Principle of Superposition of Electric Fields 226
15.3 Electric Displacement. Ostrogradsky-Gauss Electric Flux Theorem 230

CHAPTER 16 ELECTRIC FIELD POTENTIAL

16.1 Work Done in Moving an Electric Charge in an Electrostatic Field 234
16.2 Potential of an Electrostatic Field 236
16.3 Relation Between the Potential and Strength of an Electrostatic Field 240
16.4 Conductors in an Electrostatic Field 242

CHAPTER 17 CAPACITANCE

17.1 Capacitance of an Isolated Conductor 244
17.2 Mutual Capacitance. Capacitors 245

CHAPTER 18 DIELECTRICS IN AN ELECTRIC FIELD

18.1 Dipole Moments of Molecules of a Dielectric 249
18.2 Polarization of Dielectrics 251
18.3 Relation Between Displacement, Field Strength and Polarization Vectors 255
18.4 Ferroelectric Materials 257

CHAPTER 19 ENERGY OF AN ELECTRIC FIELD

19.1 Energy of a Charged Conductor and an Electric Field 260
19.2 Energy of a Polarized Dielectric 263

CHAPTER 20 DIRECT ELECTRIC CURRENT

20.1 Concept of an Electric Current 264
20.2 Current and Current Density 265
20.3 Fundamentals of the Classical Electron Theory of Electrical Conduction in Metals 267

CHAPTER 21 DIRECT CURRENT LAWS

21.1 Extraneous Forces 270
21.2 Ohm's Law and the Joule-Lenz Law 271
21.3 Kirchhoff's Laws 275

CHAPTER 22 ELECTRIC CURRENT IN LIQUIDS AND GASES

22.1 Faraday's Laws of Electrolysis. Electrolytic Dissociation 278
22.2 Atomicity of Electric Charges 280
22.3 Electrolytic Conduction of Liquids 280
22.4 Electrical Conduction in Gases 282
22.5 Various Types of Gas Discharges 283
22.6 Certain Information on Plasma 286

CHAPTER 23 MAGNETIC FIELD OF DIRECT CURRENT

23.1 Magnetic Field. Ampere's Law 290
23.2 The Biot-Savart-Laplace Law 292
23.3 Simplest Cases of Magnetic Fields Set Up by Direct Currents 296
23.4 Interaction of Conductors. Effect of a Magnetic Field on Current-Carrying Conductors 302
23.5 Total Current Law. Magnetic Circuits 304
23.6 Work Done in Moving a Current-Carrying Conductor in a Magnetic Field 308

CHAPTER 24 MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELDS

24.1 Lorentz Force 310
24.2 Hall Effect 314
24.3 Charge-to-Mass Ratio of Particles. Mass Spectroscopy 317
24.4 Charged Particle Accelerators 318

CHAPTER 25 ELECTROMAGNETIC INDUCTION

25.1 Basic Law of Electromagnetic Induction 323
25.2 Phenomenon of Self-Induction 327
25.3 Mutual Induction 330
25.4 Energy of a Magnetic Field Set Up by an Electric Current 332

此为试读,需要完整PDF请访问: www.ertongbook.com

CHAPTER 26 MAGNETIC MATERIALS IN A MAGNETIC FIELD

26.1 Magnetic Moments of Electrons and Atoms 335
26.2 An Atom in a Magnetic Field 337
26.3 Diamagnetic and Paramagnetic Materials in a Uniform Magnetic Field 340
26.4 Magnetic Field in Magnetic Materials 344
26.5 Ferromagnetic Materials 346

CHAPTER 27 FUNDAMENTALS OF MAXWELL'S THEORY

27.1 General Features of Maxwell's Theory 350
27.2 Maxwell's First Equation 351
27.3 Displacement Current. Maxwell's Second Equation 353
27.4 Complete Set of Maxwell's Equations for an Electromagnetic Field 357

PART FOUR OSCILLATIONS AND WAVES

CHAPTER 28 FREE HARMONIC OSCILLATIONS

28.1 Harmonic Oscillations 362
28.2 Mechanical Harmonic Vibrations 366
28.3 Free Harmonic Oscillations in an Oscillatory Electric Circuit 372
28.4 Adding Harmonic Oscillations 374

CHAPTER 29 DAMPED AND FORCED OSCILLATIONS

29.1 Damped Oscillations 384
29.2 Forced Mechanical Vibration 388
29.3 Forced Electrical Oscillation 393

CHAPTER 30 ELASTIC WAVES

30.1 Longitudinal and Transverse Waves in an Elastic Medium 398
30.2 Travelling Wave Equation 401

30.3 Phase Velocity and Energy of Elastic Waves 406
30.4 Principle of Superposition of Waves. Group Velocity 411
30.5 Interference of Waves. Standing Waves 414
30.6 Doppler Effect in Acoustics 420

CHAPTER 31 ELECTROMAGNETIC WAVES

31.1 Properties of Electromagnetic Waves 422
31.2 Energy of Electromagnetic Waves 427
31.3 Electromagnetic Radiation 430
31.4 Electromagnetic Spectrum 433
31.5 Reflection and Refraction of Electromagnetic Waves at the Interface Between Two Dielectric Media 435
31.6 Doppler Effect 440

PART FIVE OPTICS

CHAPTER 32 INTERFERENCE OF LIGHT

32.1 Monochromaticity and Time Coherence of Light 444
32.2 Interference of Light. Spatial Coherence of Light 446
32.3 Interference of Light in Thin Films 453
32.4 Multiwave Interference 457

CHAPTER 33 DIFFRACTION OF LIGHT

33.1 Huygens-Fresnel Principle 461
33.2 Fresnel Diffraction 465
33.3 Fraunhofer Diffraction 467
33.4 Diffraction by a Space Lattice 474
33.5 Resolving Power of Optical Instruments 476
33.6 Holography 478

CHAPTER 34 ABSORPTION, SCATTERING AND DISPERSION OF LIGHT. VAVILOV-CHERENKOV RADIATION

34.1 Interaction of Light with Matter 481
34.2 Absorption of Light 482
34.3 Scattering of Light 485
34.4 Normal and Anomalous Light Dispersion 487
34.5 Classical Electron Theory of Light Dispersion 489
34.6 Vavilov-Cherenkov Radiation 492

CHAPTER 35 POLARIZATION OF LIGHT

35.1 Polarization of Light in Reflection and Refraction at the Interface Between Two Dielectric Media 495
35.2 Birefringence (Double Refraction) 498
35.3 Interference of Polarized Light 504
35.4 Artificial Optical Anisotropy 508
35.5 Rotation of the Plane of Polarization 510

CHAPTER 36 THERMAL RADIATION

36.1 Thermal Radiation. Kirchhoff's Law 511
36.2 Stefan-Boltzmann and Wien Laws 516
36.3 Planck's Formula 518
36.4 Optical Pyrometry 522

CHAPTER 37 FUNDAMENTALS OF QUANTUM OPTICS

37.1 External Photoelectric Effect (Photoemissive Effect) 524
37.2 Mass and Momentum of the Photon. Light Pressure 528
37.3 Compton Effect 530
37.4 Wave-Particle Duality of the Properties of Light 533

PART SIX ATOMIC AND MOLECULAR PHYSICS

CHAPTER 38 ELEMENTS OF QUANTUM MECHANICS

38.1 Wave-Particle Dualism of the Properties of Particles of Matter 535
38.2 Schrödinger Wave Equation 537
38.3 Motion of a Free Particle 540
38.4 A Particle in a One-Dimensional Infinitely Deep Potential Well 541
38.5 Linear Harmonic Oscillator 543
38.6 Heisenberg Indeterminacy Principle 548
38.7 Tunnel Effect 551

CHAPTER 39 STRUCTURE OF ATOMS AND MOLECULES AND THEIR OPTICAL PROPERTIES

39.1 The Hydrogen Atom and Hydrogen-Like Ions 554
39.2 Space Quantization 559
39.3 Pauli Exclusion Principle. Mendeleev's Periodic Table 561
39.4 Chemical Bonds and Molecular Structure 563
39.5 Optical Properties of Molecules. Molecular Spectra 566
39.6 Raman Scattering of Light 568
39.7 Luminescence. X rays 570
39.8 Stimulated Emission of Radiation. Lasers 573

PART SEVEN BASIC SOLID-STATE PHYSICS

CHAPTER 40 STRUCTURE AND CERTAIN PROPERTIES OF SOLIDS

40.1 Structure of Solids 579
40.2 Thermal Expansion of Solids 580
40.3 Brief Information on the Elastic Properties of Solids 582
40.4 Basic Concepts of Phase Transitions in Solids 585

CHAPTER 41 AN OUTLINE OF THE QUANTUM PHYSICS OF SOLIDS

41.1 Basic Concepts of Quantum Statistics 588
41.2 Bose-Einstein and Fermi-Dirac Distribution Functions 589
41.3 Degeneracy of Systems of Particles Described by Quantum Statistics 592
41.4 Degenerate Electron Fermi Gas in Metals 594
41.5 Quantum Theory of Electrical Conduction in Metals 598
41.6 Superconductivity 601
41.7 Heat Capacity of Solids 605
41.8 Band Theory of Solids 610
41.9 Metals and Dielectrics in the Band Theory 613
41.10 Electrical Conduction of Semiconductors 615
41.11 Concept of Contact Electrical Phenomena in Metals and Semiconductors 620

PART EIGHT NUCLEAR PHYSICS AND ELEMENTARY PARTICLES

CHAPTER 42 STRUCTURE AND BASIC PROPERTIES OF ATOMIC NUCLEI

42.1 Main Properties and Structure of the Nucleus 626
42.2 Binding Energy of Nuclei. Mass Defect 628
42.3 Nuclear Forces 631
42.4 Radioactivity 633
42.5 Alpha Decay 637
42.6 Beta Decay 639
42.7 Gamma Rays 642
42.8 Mössbauer Effect 645
42.9 Nuclear Reactions 648

CHAPTER 43 ELEMENTARY PARTICLES

43.1 Preliminary Information on Elementary Particles 660
43.2 Classification of Elementary Particles and Their Interaction 662

43.3 Certain Information on Various Elementary Particles 665
43.4 Certain Conservation Laws in Elementary-Particle Physics 668
43.5 Antiparticles 671
43.6 Structure of the Nucleon 673

PART NINE APPENDICES

I Systems of Units of Physical Quantities 676
II Fundamental Physical Constants 681
Index 695

此为试读,需要完整PDF请访问: www.ertongbook.com