## CONTENTS

Preface to the third Russian edition		xili		
From the prefaces to previous Russian editions				
Notation				
	I. THE FUNDAMENTAL PRINCIPLES OF STATISTICAL PHYSICS	*		
000000	Statistical distributions     Statistical independence     Liouville's theorem     The significance of energy	1 6 9 11		
80000	5. The statistical matrix 6. Statistical distributions in quantum statistics 7. Entropy 8. The law of increase of entropy	14 21 23 29		
	II. THERMODYNAMIC QUANTITIES			
<b>ららまるののののののののののののののののの</b> の	<ol> <li>9. Temperature</li> <li>10. Macroscopic motion</li> <li>11. Adiabatic processes</li> <li>12. Pressure</li> <li>13. Work and quantity of heat</li> <li>14. The heat function</li> <li>15. The free energy and the thermodynamic potential</li> <li>16. Relations between the derivatives of thermodynamic quantities</li> <li>17. The thermodynamic scale of temperature</li> <li>18. The Joule-Thomson process</li> <li>19. Maximum work</li> <li>20. Maximum work done by a body in an external medium</li> <li>21. Thermodynamic inequalities</li> <li>22. Le Chatelier's principle</li> <li>23. Nernst's theorem</li> <li>24. The dependence of the thermodynamic quantities on the number of particles</li> <li>25. Equilibrium of a body in an external field</li> <li>26. Rotating bodies</li> <li>27. Thermodynamic relations in the relativistic region</li> </ol>	344 3638 4144 4748 5155 5665 5759 6365 6870 7374 76		
	III. THE GIBBS DISTRIBUTION			
000000000	<ul> <li>28. The Gibbs distribution</li> <li>29. The Maxwellian distribution</li> <li>30. The probability distribution for an oscillator</li> <li>31. The free energy in the Gibbs distribution</li> <li>32. Thermodynamic perturbation theory</li> <li>33. Expansion in powers of ħ</li> </ul>	79 82 87 91 95 98		

vi	Contents
7.1	Comenia

§	<ul><li>34. The Gibbs distribution for rotating bodies</li><li>35. The Gibbs distribution for a variable number of particles</li><li>36. The derivation of the thermodynamic relations from the Gibbs distribution</li></ul>	104 106 109
	IV. IDEAL GASES	
<i>•••••••••••••••••••••••••••••••••••••</i>	37. The Boltzmann distribution 38. The Boltzmann distribution in classical statistics 39. Molecular collisions 40. Ideal gases not in equilibrium 41. The free energy of an ideal Boltzmann gas 42. The equation of state of an ideal gas 43. Ideal gases with constant specific heat 44. The law of equipartition 45. Monatomic ideal gases 46. Monatomic gases. The effect of the electronic angular momentum 47. Diatomic gases with molecules of unlike atoms. Rotation of molecules 48. Diatomic gases with molecules of like atoms. Rotation of molecules 49. Diatomic gases. Vibrations of atoms 50. Diatomic gases. The effect of the electronic angular momentum 51. Polyatomic gases	111 113 115 118 120 121 125 129 132 135 137 141 143 144 148
ğ	52. Magnetism of gases	152
	V. THE FERMI AND BOSE DISTRIBUTIONS	
00000000000000000000000000000000000000	<ul> <li>53. The Fermi distribution</li> <li>54. The Bose distribution</li> <li>55. Fermi and Bose gases not in equilibrium</li> <li>56. Fermi and Bose gases of elementary particles</li> <li>57. A degenerate electron gas</li> <li>58. The specific heat of a degenerate electron gas</li> <li>59. Magnetism of an electron gas. Weak fields</li> <li>60. Magnetism of an electron gas. Strong fields</li> <li>61. A relativistic degenerate electron gas</li> <li>62. A degenerate Bose gas</li> <li>63. Black-body radiation</li> </ul>	158 159 160 162 166 168 171 175 178 180 183
	VI. SOLIDS	
	64. Solids at low temperatures 65. Solids at high temperatures 66. Debye's interpolation formula 67. Thermal expansion of solids 68. Highly anisotropic crystals 69. Crystal lattice vibrations 70. Number density of vibrations 71. Phonons 72. Phonon creation and annihilation operators 73. Negative temperatures	191 195 198 201 203 207 211 215 218 221
	VII. NON-IDEAL GASES	
ş	74. Deviations of gases from the ideal state 75. Expansion in powers of the density 76. Van der Waals' formula 77. Relationship of the virial coefficient and the scattering amplitude 78. Thermodynamic quantities for a classical plasma	225 230 232 236 239

	·				
	Contents	vii			
	79. The method of correlation functions	243			
§	80. Thermodynamic quantities for a degenerate plasma	245			
	VIII. PHASE EQUILIBRIUM				
	81. Conditions of phase equilibrium	251			
	82. The Clapeyron-Clausius formula	255 257			
	83. The critical point 84. The law of corresponding states	260			
8					
	IX. SOLUTIONS				
_	85. Systems containing different particles	263			
	86. The phase rule 87. Weak solutions	264 265			
§	88. Osmotic pressure	267			
§	89. Solvent phases in contact	268			
	90. Equilibrium with respect to the solute	271			
-	91. Evolution of heat and change of volume on dissolution	274			
	92. Solutions of strong electrolytes	277 2 <b>7</b> 9			
~	93. Mixtures of ideal gases 94. Mixtures of isotopes	281			
	95. Vapour pressure over concentrated solutions	283			
§	96. Thermodynamic inequalities for solutions	286			
§	97. Equilibrium curves	289			
	98. Examples of phase diagrams	295 300			
	99. Intersection of singular curves on the equilibrium surface 100. Gases and liquids	300 301			
8	100. Gases and negution	50.			
	X. CHEMICAL REACTIONS				
	101. The condition for chemical equilibrium	305			
	102. The law of mass action	306			
-	103. Heat of reaction 104. Ionisation equilibrium	310 313			
-	105. Equilibrium with respect to pair production	315			
•	•				
XI. PROPERTIES OF MATTER AT VERY HIGH DENSITY					
	106. The equation of state of matter at high density	317			
	107. Equilibrium of bodies of large mass 108. The energy of a gravitating body	320 327			
	109. Equilibrium of a neutron sphere	329			
	XII. FLUCTUATIONS				
Ş	110. The Gaussian distribution	333			
ş	111. The Gaussian distribution for more than one variable	335			
•	112. Fluctuations of the fundamental thermodynamic quantities	338			
	113. Fluctuations in an ideal gas	345			
	114. Poisson's formula 115. Fluctuations in solutions	347 349			
	116. Spatial correlation of density fluctuations	350			
	117. Correlation of density fluctuations in a degenerate gas	354			
	118. Correlations of fluctuations in time	359			
§	119. Time correlations of the fluctuations of more than one variable	363			

viii Contents

§ 12 § 12 § 12	20. The symmetry of the kinetic coefficients 21. The dissipative function 22. Spectral resolution of fluctuations 23. The generalised susceptibility 24. The fluctuation—dissipation theorem	365 368 371 377 384					
	25. The fluctuation-dissipation theorem for more than one variable	389					
	26. The operator form of the generalised susceptibility	393					
	27. Fluctuations in the curvature of long molecules	396					
XIII. THE SYMMETRY OF CRYSTALS							
8 11	28. Symmetry elements of a crystal lattice	401					
8 12	29. The Bravais lattice	403					
	30. Crystal systems	40:					
•	31. Crystal classes	409					
	32. Space groups	413					
	33. The reciprocal lattice	413					
	34. Irreducible representations of space groups	416					
	35. Symmetry under time reversal	422					
	36. Symmetry properties of normal vibrations of a crystal lattice	42					
	37. Structures periodic in one and two dimensions	432					
	38. The correlation function in two-dimensional systems	436					
	39. Symmetry with respect to orientation of molecules	438					
	40. Nematic and cholesteric liquid crystals	440					
	41. Fluctuations in liquid crystals	442					
3 .	11. 1 Institutions in inquire oxystats						
	XIV. PHASE TRANSITIONS OF THE SECOND KIND AND CRITICAL						
	PHENOMENA						
	THENOMENA						
§ 1	42. Phase transitions of the second kind	446					
\$ 14	43. The discontinuity of specific heat	451					
§ 14	44. Effect of an external field on a phase transition	450					
§ 1	45. Change in symmetry in a phase transition of the second kind	459					
§ 14	46. Fluctuations of the order parameter	47					
§ 1	47. The effective Hamiltonian	478					
§ 1	48. Critical indices	483					
§ 1	49. Scale invariance	489					
\$ 1.	50. Isolated and critical points of continuous transition	493					
§ 1:	51. Phase transitions of the second kind in a two-dimensional lattice	498					
§ 1.	52. Van der Waals theory of the critical point	500					
§ 1	53. Fluctuation theory of the critical point	51					
	XV. SURFACES						
		51					
	54. Surface tension	00000000					
	55. Surface tension of crystals	520					
	56. Surface pressure	522					
§ 1.	57. Surface tension of solutions	524					
	58. Surface tension of solutions of strong electrolytes	520					
	59. Adsorption	52° 529					
	60. Wetting						
•	61. The angle of contact	53					
§ 1	62. Nucleation in phase transitions	533					
§ 1	63. The impossibility of the existence of phases in one-dimensional systems	53					
Inc	dex	539					