

CONTENTS

I. INTRODUCTION

1. Probability	1
2. Mean values	3
3. Statistical independence	5

II. STATISTICAL DISTRIBUTION AND ENTROPY

4. Statement of the problem	7
5. Phase space. Liouville's theorem	9
6. The role of the energy	12
7. Entropy	16
8. The law of increasing entropy	19

III. THE THERMODYNAMIC FUNCTIONS

9. Temperature	26
10. Macroscopic motion	28
11. Adiabatic processes	29
12. Pressure	31
13. Work and quantity of heat. Specific heats	34
14. The maximum work	36
15. The heat function	38
16. Stationary flow	38
17. The Helmholtz and Gibbs free energies	41
18. Transformation of variables	45
19. Rotating bodies	47

IV. THE GIBBS DISTRIBUTION

20. The Gibbs distribution	50
21. The Maxwell distribution	55
22. Collisions with the walls of the vessel	60
23. Collisions of the molecules with each other	61
24. Rotation of molecules	62
25. Rotating bodies	64
26. A perfect gas in an external field of force	64

V. DETERMINATION OF THE THERMODYNAMIC FUNCTIONS

27. General formulae	67
28. The perfect gas	69
29. A perfect gas not in equilibrium	73
30. Mixtures of perfect gases	75

CONTENTS

vii

31. Deviations from the perfect gas	77
32. Van der Waals' equation	80
33. The equipartition law	84
34. Solids	93

VI. FLUCTUATIONS AND THERMODYNAMIC INEQUALITIES

35. The thermodynamic inequalities	98
36. The critical point	102
37. The Le Chatelier-Braun principle	104
38. The Gaussian distribution	107
39. The Gaussian distribution for several quantities	110
40. Fluctuations of the thermodynamic functions	114
41. Approach to the equilibrium state	118
42. The dissipation function	121

VII. THE CHEMICAL POTENTIAL

43. Dependence of the thermodynamic functions on the number of particles	124
44. Equilibrium of systems in a field	125
45. Mechanical equilibrium	127
46. The Gibbs distribution for a system with a variable number of particles	131
47. The chemical potential in the Boltzmann distribution	134

VIII. PHASE EQUILIBRIUM

48. The conditions for equilibrium of phases	136
49. The Clapeyron-Clausius equation	140
50. The critical point	142
51. Gas and liquid	148

IX. SOLUTIONS

52. Systems with different kinds of particles	152
53. Dilute solutions	155
54. Osmotic pressure	157
55. Contact of phases of the solvent	159
56. Equilibrium with respect to the solute	162
57. Mutual influence of two solutes in solution	163
58. Evolution of heat and change of volume in the process of solution	165
59. Fluctuations and thermodynamic inequalities for solutions	167
60. Vapour pressure of a solution	172
61. Equilibrium curves	174
62. Examples of equilibrium diagrams	182
63. The intersections of the special lines on the equilibrium surface	187
64. Gas and liquid	189

CONTENTS**X. CHEMICAL REACTIONS**

65. Conditions for chemical equilibrium	193
66. The law of mass action	194
67. The heat of reaction	197

XI. ANISOTROPIC BODIES

68. Anisotropic bodies	200
69. Transition points	204
70. The critical Curie point	209
71. Isolated Curie points	214
72. Ordered solid solutions	215

XII. SURFACE PHENOMENA

73. Surface tension	218
74. Surface pressure	221
75. Formation of nuclei	225
76. The growth of crystals	228
77. Adsorption	230
78. Two-dimensional and one-dimensional systems	231

INDEX

233