

CONTENTS

CHAPTER I. INTRODUCTION	1
CHAPTER II. ENTROPY AND PROBABILITY	2
2.1. The Boltzmann distribution for distinguishable particles	3
2.2. The Boltzmann distribution for a gas	8
2.3. Entropy and disorder	11
2.4. The constants β and k	13
CHAPTER III. ENTROPY AND INTERNAL DEGREES OF FREEDOM	18
3.1. The partition function	18
3.2. The entropy of a perfect gas	20
3.3. The entropy of spin systems and degeneracy	22
3.4. The entropy of molecular rotation	26
3.5. The entropy of mixing of perfect gases	27
3.6. Aspects and entropy	32
CHAPTER IV. THE THIRD LAW OF THERMODYNAMICS	32
4.1. Specific heats and absolute zero	33
4.2. The entropy of allotropic solids	37
4.3. Some miscellaneous consequences	38
4.4. Superconductivity	41
4.5. Zero point energy	43
4.6. Liquid helium	45
CHAPTER V. THE THIRD LAW AND INTERNAL DEGREES OF FREEDOM	54
5.1. The entropy of gases	54
5.2. Supercooled liquids at low temperatures	57
5.3. Glasses and the Third Law	58
5.4. Frozen-in states	63
5.5. Hindered rotation	66
CHAPTER VI. THE STATISTICS OF A PERFECT GAS	68
6.1. Indistinguishability and statistics	68
6.2. The Bose-Einstein distribution for a perfect gas	70
6.3. Bose-Einstein statistics and the radiation laws	71
6.4. The thermodynamic properties of a Bose-Einstein gas	74
6.5. Fermi-Dirac statistics	80
CHAPTER VII. THE STATISTICAL BASIS OF THE THIRD LAW	81
7.1. The entropy and specific heat of a simple lattice	82
7.2. Gases and liquid helium	84
7.3. Electrons in metals	86
7.4. The Third Law and statistical mechanics	87

CHAPTER VIII. NUCLEI AND ENTROPY	89
8.1. Isotopes	89
8.2. Nuclear spin	92
8.3. Nuclei and symmetry	93
8.4. The entropy of hydrogen	97
CHAPTER IX. CHEMICAL EQUILIBRIA	101
9.1. The equilibrium constant	102
9.2. Equilibrium constants and the Third Law	104
9.3. The chemical constants	107
9.4. The graphite-diamond transition	110
CHAPTER X. THE UNATTAINABILITY OF ABSOLUTE ZERO	113
10.1. The Third Law and unattainability	113
10.2. Negative temperatures	115
10.3. Alternative formulations of the Third Law	119
10.4. Magnetic cooling	121
10.5. The Third Law and low temperature physics	126
10.6. Entropy at low temperatures	129
10.7. The lowest temperatures	132
REFERENCES AND AUTHOR INDEX	135
SUBJECT INDEX	141