
STATISTICAL MECHANICS: A COMPLETE GUIDE

PHYS 449

AUGUST 29, 2021

ELIJAH THOMPSON,
PHYSICS AND MATH HONORS

Solo Pursuit of Learning



Contents

I	Thermodynamics	2
1	Energy in Thermal Physics	3
2	Thermodynamical Systems	4
3	Thermodynamical Potentials and Equilibrium	5
II	Statistical Mechanics	6
4	Microstates and Entropy	7
5	Ensemble Theory and Free Energy	8
6	Boltzmann Statistics and the Canonical Ensemble	9
7	Breakdown of Classical Statistical Mechanics	10
III	Probability Theory	11
8	Characteristics of Probability Theory	12
9	Continuous Random Variables and the Gaussian Distribution	13
10	Information and Entropy	14
IV	Real Gases and Phase Transitions	15
11	Kinetic Theory of Gases	16
12	Classification of Phase Transitions	17
V	Quantum Statistics	18
13	Quantum States	19
14	Ideal Quantum Gases	20
	Appendices	21

Part I

Thermodynamics

Chapter 1

Energy in Thermal Physics

Chapter 2

Thermodynamical Systems

Chapter 3

Thermodynamical Potentials and Equilibrium

Part II

Statistical Mechanics

Chapter 4

Microstates and Entropy

Chapter 5

Ensemble Theory and Free Energy

Chapter 6

Boltzmann Statistics and the Canonical Ensemble

Chapter 7

Breakdown of Classical Statistical Mechanics

Part III

Probability Theory

Chapter 8

Characteristics of Probability Theory

Chapter 9

Continuous Random Variables and the Gaussian Distribution

Chapter 10

Information and Entropy

Part IV

Real Gases and Phase Transitions

Chapter 11

Kinetic Theory of Gases

Chapter 12

Classification of Phase Transitions

Part V

Quantum Statistics

Chapter 13

Quantum States

Chapter 14

Ideal Quantum Gases

Appendices