

TABLE OF CONTENTS

Licensing

Preface

1: Foundations and Review

- 1.1: Some Newtonian Physics
- 1.2: Some Vectors and Dot Products
- 1.3: Classical Description of a Wave on a String
- 1.4: Failures of Classical Physics
- 1.5: On Superposition and the Weirdness of Quantum Mechanics
- 1.6: References
- 1.7: Vocabulary and Concepts
- 1.8: Problems

2: Particle in a Box

- 2.1: Background
- 2.2: The Postulates of Quantum Mechanics
- 2.3: The One-Dimensional Particle in a Box
- 2.4: The Tools of Quantum Mechanics
- 2.5: Superposition and Completeness
- 2.6: Problems in Multiple Dimensions
- 2.7: The Free Electron Model
- 2.8: Entanglement and Schrödinger's Cat
- 2.9: References
- 2.10: Vocabulary and Concepts
- 2.11: Problems

3: An Introduction to Group Theory

- 3.1: Overview
- 3.2: Group Theory in Chemistry
- 3.3: Determining the Point Group for a Molecule- the Schoenflies notation
- 3.4: Multiplication Operation for Symmetry Elements
- 3.5: More Definitions- Order and Class
- 3.6: Representations
- 3.7: The "Great Orthogonality Theorem"
- 3.8: Character and Character Tables
- 3.9: Direct Products
- 3.10: Vocabulary and Concepts
- 3.11: Problems

4: The Harmonic Oscillator and Vibrational Spectroscopy

- 4.1: The Potential Energy Surface for a Diatomic Molecule
- 4.2: Solving the Schrödinger Equation
- 4.3: Strengths and Weaknesses
- 4.4: Vibrational Spectroscopy Techniques
- 4.5: Group Theory Considerations

- 4.6: References
- 4.7: Vocabulary and Concepts
- 4.8: Problems

5: The Rigid Rotor and Rotational Spectroscopy

- 5.1: Spherical Polar Coordinates
- 5.2: Potential Energy and the Hamiltonian
- 5.3: Solution to the Schrödinger Equation
- 5.4: Spherical Harmonics
- 5.5: Angular Momentum
- 5.6: Application to the Rotation of Real Molecules
- 5.7: Spectroscopy
- 5.8: References
- 5.9: Vocabulary and Concepts
- 5.10: Problems

6: The Hydrogen Atom

- 6.1: Older Models of the Hydrogen Atom
- 6.2: The Quantum Mechanical H-atom
- 6.3: Rydberg Spectra of Polyelectronic Atoms
- 6.4: References
- 6.5: Vocabulary and Concepts
- 6.6: Problems

7: Approximate Methods

- 7.1: Perturbation Theory
- 7.2: Variational Method
- 7.3: Vocabulary and Concepts
- 7.4: Problems

8: Polyelectronic Atoms

- 8.1: Potential Energy and the Hamiltonian
- 8.2: The Aufbau Principle
- 8.3: Orbital Diagrams
- 8.4: Angular Momentum Coupling
- 8.5: The Pauli Exclusion Principle
- 8.6: Atomic Spectroscopy
- 8.7: Vocabulary and Concepts
- 8.8: Learning Objectives
- 8.9: Problems

9: Molecules

- 9.1: Potential Energy and the Hamiltonian
- 9.2: The Born-Oppenheimer Approximation
- 9.3: Molecular Orbital Theory
- 9.4: Hund's coupling cases (a) and (b)
- 9.5: Diatomic Term Symbols
- 9.6: Herzberg Diagrams
- 9.7: Vibronic Transitions
- 9.8: Term Symbols for Polyatomic Molecules

- 9.9: Group Theoretical Approach to Molecular Orbitals
- 9.10: References
- 9.11: Vocabulary and Concepts
- 9.12: Learning Objectives

10: Lasers

- 10.1: Fractional Population of Quantum States
- 10.2: Types of Lasers
- 10.3: Examples of Laser Systems
- 10.4: Laser Spectroscopy
- 10.5: References
- 10.6: Vocabulary and Concepts
- 10.7: Problems

11: Quantum Strangeness

- 11.1: Nodes and Wave Nature
- 11.2: Quantum Interference
- 11.3: The Stern-Gerlach Experiment
- 11.4: Spooky Action at a Distance
- 11.5: Bell's Inequality
- 11.6: References

12: Appendices

- 12.1: Appendix I
- 12.2: Appendix II – Selected Character Tables

[Index](#)

[Glossary](#)

[Detailed Licensing](#)