

Chapter 1

Introduction

This chapter gives an overview of some of the topics that will be covered so the reader can get a coherent picture of the types of problems and associated mathematical structures that will be developed.¹

1.1 The Classical Water Molecule and the Ozone Molecule

An example that will be used to illustrate various concepts throughout these lectures is the *classical (non-quantum) rotating “water molecule”*. This system consists of three particles interacting by interparticle conservative forces (one can think of springs connecting the particles, for example) so that the total energy of the system, which will be taken as our Hamiltonian, is the sum of the kinetic and potential energies. This system is shown in Figure 1.1.1. The interesting special case of three equal masses gives the “ozone” molecule.

We use the term “water molecule” mainly for terminological convenience. The full problem is of course the classical *three body problem* in space. However, thinking of it as a rotating system evokes certain constructions that we wish to illustrate.

Imagine this mechanical system rotating in space and, simultaneously, undergoing vibratory, or *internal* motions. We can ask a number of questions:

- How does one set up the *equations of motion* for this system?

¹We are grateful to Oliver O’Reilly, Rick Wicklin, and Brett Zombre for providing a helpful draft of the notes for an early version of this lecture.

Chapter 1 Introduction And Overview

Yi-Tong Ma



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Table of Contents Chapter 1 Introduction And Overview

1. Understanding the eBook Chapter 1 Introduction And Overview
 - The Rise of Digital Reading Chapter 1 Introduction And Overview
 - Advantages of eBooks Over Traditional Books
2. Identifying Chapter 1 Introduction And Overview
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Chapter 1 Introduction And Overview
 - User-Friendly Interface
4. Exploring eBook Recommendations from Chapter 1 Introduction And Overview
 - Personalized Recommendations
 - Chapter 1 Introduction And Overview User Reviews and Ratings
 - Chapter 1 Introduction And Overview and Bestseller Lists
5. Accessing Chapter 1 Introduction And Overview Free and Paid eBooks
 - Chapter 1 Introduction And Overview Public Domain eBooks
 - Chapter 1 Introduction And Overview eBook Subscription Services
 - Chapter 1 Introduction And Overview Budget-Friendly Options
6. Navigating Chapter 1 Introduction And Overview eBook Formats

- ePub, PDF, MOBI, and More
- Chapter 1 Introduction And Overview Compatibility with Devices
- Chapter 1 Introduction And Overview Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Chapter 1 Introduction And Overview
 - Highlighting and Note-Taking Chapter 1 Introduction And Overview
 - Interactive Elements Chapter 1 Introduction And Overview
- 8. Staying Engaged with Chapter 1 Introduction And Overview
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Chapter 1 Introduction And Overview
- 9. Balancing eBooks and Physical Books Chapter 1 Introduction And Overview
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Chapter 1 Introduction And Overview
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Chapter 1 Introduction And Overview
 - Setting Reading Goals Chapter 1 Introduction And Overview
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Chapter 1 Introduction And Overview
 - Fact-Checking eBook Content of Chapter 1 Introduction And Overview
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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