# chapter 7

# Gravitation

#### Chapter Contents

- Introduction
- Universal Law of Gravitation
- Acceleration Due to Gravity upon the Earth's Surface
- Acceleration Due to Gravity above the Surface of Earth
- Acceleration Due to Gravity below the Surface of Earth
- Gravitational Potential Energy of an Object in the Field of Earth
- Earth Satellite
- Energy of an Orbiting Satellite
- Geostationary and Polar Satellites
- Weightlessness
- Some Important Definitions
- Pormulae Chart
- Quick Recap

#### Introduction

Have you ever wondered, why does anything thrown up fall down? Why does not the moon fall to the earth? Why does not the earth fly off into space rather than remaining in orbit around the sun? Why do all the planets revolve around the sun? Why is the life of astronauts inside an orbiting satellite very different? Why is going uphill is lot more tiring than going downhill? In all these cases, there must be some force acting on the moon, the planets and the falling bodies. The force acting on them is called Gravitational force.

In this chapter we shall learn about the basic laws governing gravitation and the motion of objects under the influence of gravitation. We shall apply the law of gravitation to phenomena such as the variation of weight with altitude, the orbits of satellites around the earth and the orbits of planets around the sun.

#### UNIVERSAL LAW OF GRAVITATION

"Every particle of matter in the universe attracts every other particle with a force that is directly proportional to the product of the masses of the particles and inversely proportional to the square of the distance between them".

$$\left|\vec{F}\right| \sim m_1 m_2$$

$$|F| \sim \frac{1}{r^2}$$

$$|\vec{F}| \sim \frac{m_i m_j}{r^2}$$

or 
$$|\vec{F}| = \frac{Gm_r m_r}{r^2}$$

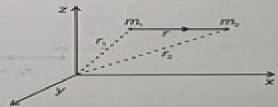


Fig.: Gravitational force on  $m_1$  due to  $m_2$  is along  $\bar{r}$  where the vector  $\bar{r}$  is  $(\bar{r}_2 - \bar{r}_1)$ 

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#### **Table of Contents Physics Chapter 7 Gravitation Study Guide Answers**

- 1. Understanding the eBook Physics Chapter 7 Gravitation Study Guide Answers
  - The Rise of Digital Reading Physics Chapter 7 Gravitation Study Guide Answers
  - Advantages of eBooks Over Traditional Books
- 2. Identifying Physics Chapter 7 Gravitation Study Guide Answers
  - 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 Physics Chapter 7 Gravitation Study Guide Answers
  - User-Friendly Interface
- 4. Exploring eBook Recommendations from Physics Chapter 7 Gravitation Study Guide Answers

- Personalized Recommendations
- Physics Chapter 7 Gravitation Study Guide Answers User Reviews and Ratings
- Physics Chapter 7 Gravitation Study Guide Answers and Bestseller Lists
- 5. Accessing Physics Chapter 7 Gravitation Study Guide Answers Free and Paid eBooks
  - Physics Chapter 7 Gravitation Study Guide Answers Public Domain eBooks
  - Physics Chapter 7 Gravitation Study Guide Answers eBook Subscription Services
  - Physics Chapter 7 Gravitation Study Guide Answers Budget-Friendly Options
- 6. Navigating Physics Chapter 7 Gravitation Study Guide Answers eBook Formats
  - o ePub, PDF, MOBI, and More
  - Physics Chapter 7 Gravitation Study Guide Answers Compatibility with Devices
  - Physics Chapter 7 Gravitation Study Guide Answers Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - o Adjustable Fonts and Text Sizes of Physics Chapter 7 Gravitation Study Guide Answers
  - Highlighting and Note-Taking Physics Chapter 7 Gravitation Study Guide Answers
  - Interactive Elements Physics Chapter 7 Gravitation Study Guide Answers
- 8. Staying Engaged with Physics Chapter 7 Gravitation Study Guide Answers
  - o Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Physics Chapter 7 Gravitation Study Guide Answers
- 9. Balancing eBooks and Physical Books Physics Chapter 7 Gravitation Study Guide Answers
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Physics Chapter 7 Gravitation Study Guide Answers
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Physics Chapter 7 Gravitation Study Guide Answers
  - Setting Reading Goals Physics Chapter 7 Gravitation Study Guide Answers
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Physics Chapter 7 Gravitation Study Guide Answers

- Fact-Checking eBook Content of Physics Chapter 7 Gravitation Study Guide Answers
- 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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