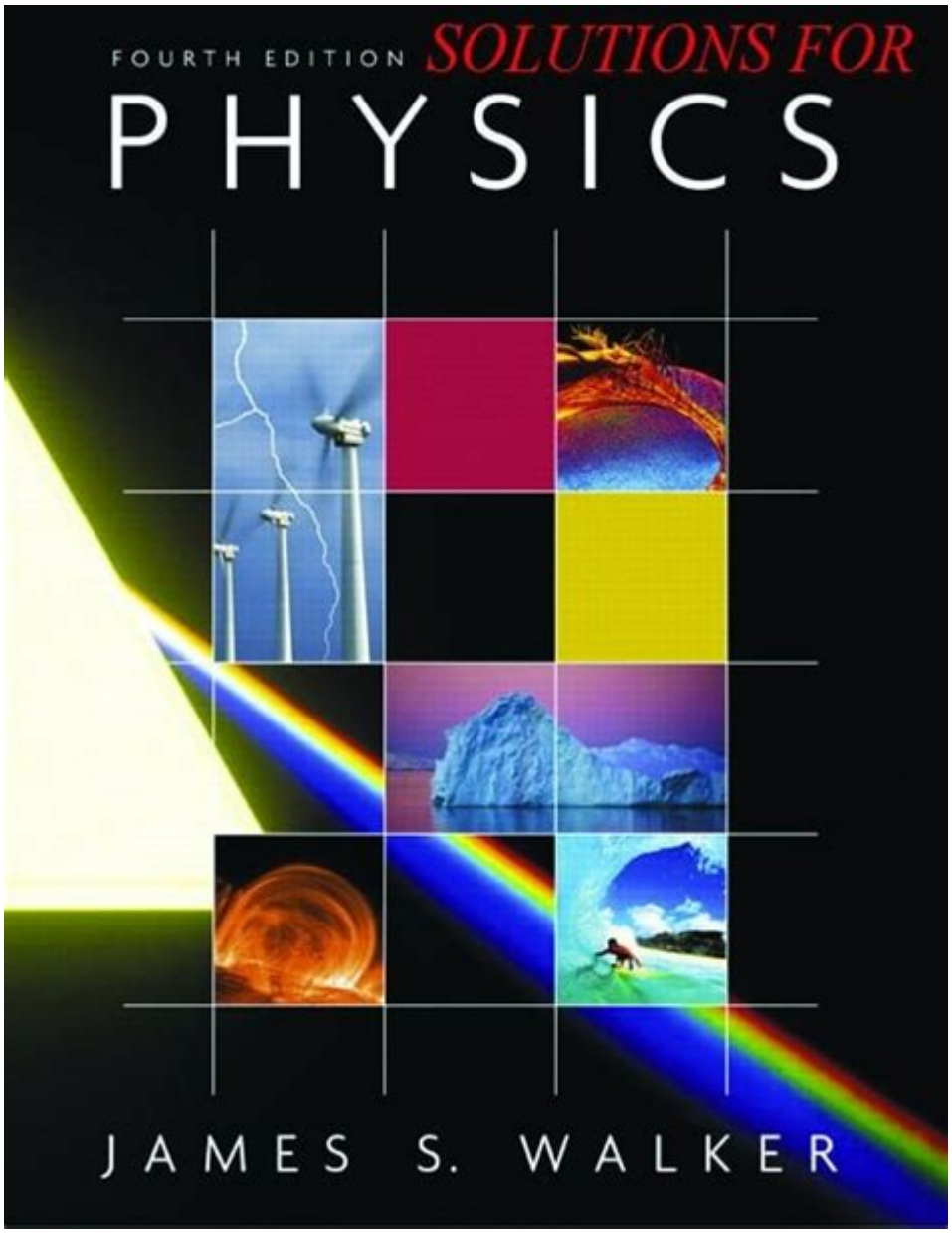
Walker Physics 4th Edition Chapter 14 Solutions



Walker Physics 4th Edition Chapter 14 Solutions are essential for students seeking a deeper understanding of the principles of physics, particularly those related to the concepts of waves and sound. This chapter delves into a variety of topics including the properties of waves, sound propagation, and the mathematical formulations that describe these phenomena. In this article, we will explore the key concepts from Chapter 14, the solutions to selected problems, and highlight the importance of mastering these topics for success in physics.

Overview of Chapter 14: Waves and Sound

Chapter 14 focuses on the fundamental principles governing waves and sound, exploring their

characteristics, behavior, and mathematical representations. Understanding these concepts is crucial for students as they form the basis for more advanced topics in physics.

Key Concepts

- Wave Properties: Waves can be classified into different types based on their properties. The main characteristics include:
- Wavelength: The distance between successive crests or troughs in a wave.
- Frequency: The number of oscillations or cycles that occur in a unit of time.
- Amplitude: The maximum displacement of points on a wave from their rest position.
- Speed: The velocity at which the wave propagates through a medium.

- Types of Waves:
- Mechanical Waves: Require a medium to travel through (e.g., sound waves).
- Electromagnetic Waves: Do not require a medium and can travel through a vacuum (e.g., light waves).
- Transverse and Longitudinal Waves: Transverse waves oscillate perpendicular to the direction of wave travel, while longitudinal waves oscillate parallel to the direction of travel.

- Sound Waves: A specific type of mechanical wave that propagates through compressions and rarefactions in a medium, typically air.

Mathematical Formulations

Understanding the mathematical descriptions of waves is critical for solving problems in Chapter 14. Key equations include:

1. Wave Speed Formula:
$$
v = f \lambda
$$
where v is the wave speed, f is the frequency, and λ is the wavelength.

2. Sound Intensity Level:
$$
L = 10 \log_{10} \left(\frac{I}{I_0} \right)
$$
where L is the sound level in decibels (dB), I is the intensity of the sound, and I_0 is the reference intensity level.

3. Doppler Effect:
$$
f' = f \left(\frac{v + v_o}{v - v_s} \right)
$$
where f' is the observed frequency, v is the speed of sound, v_o is the speed of the observer, and v_s is the speed of the source.

Solutions to Selected Problems

In Walker Physics 4th Edition, Chapter 14 provides numerous problems to solidify understanding of waves and sound. Below are solutions to a few selected problems that exemplify the application of concepts discussed.

Problem 14.1: Calculating Wave Speed

Problem Statement: A wave travels through a medium with a frequency of 500 Hz and a wavelength of 2 meters. Calculate the speed of the wave.

Solution:
Using the wave speed formula:
$$
v = f \lambda
$$
Substituting the values:
$$
v = 500 \, \text{Hz} \times 2 \, \text{m} = 1000 \, \text{m/s}
$$
Thus, the speed of the wave is 1000 m/s.

Problem 14.2: Sound Intensity Level Calculation

Problem Statement: A sound source emits an intensity of $5 \times 10^{-6} \, \text{W/m}^2$. Calculate the sound intensity level in decibels.

Solution:
Using the sound intensity level formula:
$$
L = 10 \log_{10} \left(\frac{I}{I_0} \right)
$$
Assuming $I_0 = 1 \times 10^{-12} \, \text{W/m}^2$:
$$
L = 10 \log_{10} \left(\frac{5 \times 10^{-6}}{1 \times 10^{-12}} \right) = 10 \log_{10} (5 \times 10^6)
$$
Calculating:
$$
L = 10 \left(\log_{10} 5 + \log_{10} 10^6 \right) = 10 \left(0.699 + 6 \right) = 10 \times 6.699 = 66.99 \, \text{dB}
$$
Thus, the sound intensity level is approximately 67.0 dB.

Problem 14.3: Applying the Doppler Effect

Problem Statement: A police siren emits a frequency of 1200 Hz. If the police car is moving towards a stationary observer at a speed of 30 m/s, calculate the frequency observed by the observer. Assume the speed of sound in air is 343 m/s.

Solution:
Using the Doppler Effect formula:
$$
f' = f \left(\frac{v + v_o}{v - v_s} \right)
$$
Where:
- $f = 1200 \, \text{Hz}$
- $v = 343 \, \text{m/s}$
- $v_o = 0$ (observer is stationary)
- $v_s = 30 \, \text{m/s}$

Substituting the values:
$$
f' = 1200 \left(\frac{343 + 0}{343 - 30} \right) = 1200 \left(\frac{343}{313} \right) \approx 1200 \times 1.095 = 1314 \, \text{Hz}
$$
Thus, the frequency observed by the observer is approximately 1314 Hz.

Importance of Mastering Wave and Sound Concepts

Mastering the concepts presented in Walker Physics 4th Edition Chapter 14 Solutions is crucial for several reasons:

- Foundation for Advanced Topics: A solid understanding of waves and sound lays the groundwork for more complex topics in physics, such as optics and quantum mechanics.

- Real-World Applications: Knowledge of wave phenomena is applicable in various fields, including acoustics, engineering, and even medical imaging technologies like ultrasound.

- Problem-Solving Skills: Engaging with the problems in this chapter enhances analytical and problem-solving skills, which are essential not only in physics but in all scientific disciplines.

- Preparation for Exams: Mastery of these concepts is vital for success in exams and standardized tests that assess understanding of physical principles.

In conclusion, Walker Physics 4th Edition Chapter 14 Solutions serves as a comprehensive guide for students to explore the fascinating world of waves and sound. By engaging with the material, solving problems, and understanding real-world applications, students can significantly enhance their physics knowledge and skills.

Frequently Asked Questions

What are the key concepts covered in Chapter 14 of Walker Physics 4th Edition?

Chapter 14 focuses on the principles of thermodynamics, including the laws of thermodynamics, heat transfer, and the behavior of ideal gases.

Where can I find the solutions for Chapter 14 in Walker Physics 4th Edition?

Solutions for Chapter 14 can typically be found in the textbook's companion resources, such as a solutions manual or online platforms that offer educational resources.

Are the solutions provided in Walker Physics 4th Edition Chapter 14 detailed enough for understanding the concepts?

Yes, the solutions are designed to be comprehensive, providing step-by-step explanations to help students grasp the underlying concepts and methodologies.

How can I effectively use the solutions from Chapter 14 to prepare for exams?

To prepare for exams, work through the problems systematically, review the explanations provided, and ensure you understand each step before moving on to the next problem.

What types of problems are included in Chapter 14 of Walker Physics 4th Edition?

The chapter includes a variety of problems such as calculating work done in thermodynamic processes, understanding heat engines, and applying the ideal gas law.

Can I find additional practice problems related to Chapter 14 of Walker Physics 4th Edition?

Yes, many educational websites and forums provide additional practice problems and resources that align with the concepts discussed in Chapter 14.

Is there a difference in the solutions provided in Walker Physics 4th Edition compared to previous editions?

Yes, each edition may include updated problems and solutions, reflecting new teaching methods and advancements in the field of physics.

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