

Chapter 19

MECHANICAL VIBRATIONS

PROBLEM NO. 1

Determine the maximum velocity and maximum acceleration of a particle which moves in simple harmonic motion with an amplitude of 3 mm and a frequency of 20 Hz.

SOLUTION:

Frequency:

$$f = 20 \text{ Hz}$$

Amplitude:

$$\omega_n = 2\pi f = (2\pi)(20) = 125.66 \text{ rad/s}$$

$$x_m = 3 \text{ mm}$$

Simple harmonic motion:

$$x = x_m \sin(\omega_n t + \phi)$$

$$v = \dot{x} = \omega_n x_m \cos(\omega_n t + \phi)$$

Maximum Velocity:

$$v_m = \omega_n x_m = (125.66 \text{ rad/s})(3 \text{ mm})$$
$$= 377 \text{ mm/s}$$

$$\underline{v_m = 0.377 \text{ m/s}}$$

Maximum acceleration:

$$a_m = \omega_n^2 x_m = (125.66 \text{ rad/s})^2 (3 \text{ mm})$$
$$= 47.3 \times 10^3 \text{ mm/s}^2$$

$$\underline{a_m = 47.3 \text{ m/s}^2}$$

Mechanical Vibrations Study Guide

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Table of Contents Mechanical Vibrations Study Guide

1. Understanding the eBook Mechanical Vibrations Study Guide
 - The Rise of Digital Reading Mechanical Vibrations Study Guide
 - Advantages of eBooks Over Traditional Books
2. Identifying Mechanical Vibrations Study Guide
 - 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 Mechanical Vibrations Study Guide
 - User-Friendly Interface
4. Exploring eBook Recommendations from Mechanical Vibrations Study Guide
 - Personalized Recommendations
 - Mechanical Vibrations Study Guide User Reviews and Ratings
 - Mechanical Vibrations Study Guide and Bestseller Lists
5. Accessing Mechanical Vibrations Study Guide Free and Paid eBooks
 - Mechanical Vibrations Study Guide Public Domain eBooks
 - Mechanical Vibrations Study Guide eBook Subscription Services
 - Mechanical Vibrations Study Guide Budget-Friendly Options

6. Navigating Mechanical Vibrations Study Guide eBook Formats
 - ePub, PDF, MOBI, and More
 - Mechanical Vibrations Study Guide Compatibility with Devices
 - Mechanical Vibrations Study Guide Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Mechanical Vibrations Study Guide
 - Highlighting and Note-Taking Mechanical Vibrations Study Guide
 - Interactive Elements Mechanical Vibrations Study Guide
8. Staying Engaged with Mechanical Vibrations Study Guide
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Mechanical Vibrations Study Guide
9. Balancing eBooks and Physical Books Mechanical Vibrations Study Guide
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Mechanical Vibrations Study Guide
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Mechanical Vibrations Study Guide
 - Setting Reading Goals Mechanical Vibrations Study Guide
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Mechanical Vibrations Study Guide
 - Fact-Checking eBook Content of Mechanical Vibrations Study Guide
 - 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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