

Particle Motion in Two Dimensions Model Worksheet 4: Projectile Motion Problems

1. A metal sphere is launched with an initial velocity of 1.5 m/s as it leaves the ramp. The end of the ramp is 1.20 m above the floor. Calculate the range of the sphere. (Range is the horizontal displacement of the projectile.)



$$\Delta y = -1.2 \text{ m}$$

$$v_{yi} = 0.51 \frac{\text{m}}{\text{s}}$$

$$a = g = -10 \frac{\text{m}}{\text{s}^2}$$

$$v_x = 1.4 \frac{\text{m}}{\text{s}}$$

$$\Delta t = ?$$

$$\Delta x = ?$$

$$v_x = \cos 20^\circ (1.5 \frac{\text{m}}{\text{s}}) = 1.4 \frac{\text{m}}{\text{s}}$$

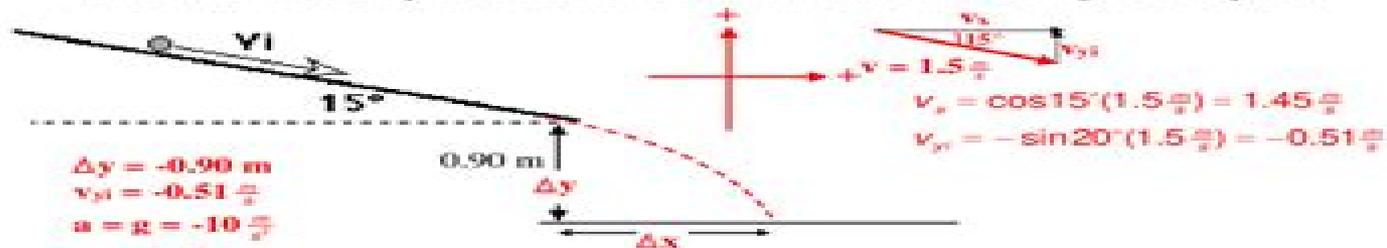
$$v_{yi} = \sin 20^\circ (1.5 \frac{\text{m}}{\text{s}}) = 0.51 \frac{\text{m}}{\text{s}}$$

$$\Delta y = v_{yi}t + \frac{1}{2}at^2 \Rightarrow -1.2\text{m} = (0.51 \frac{\text{m}}{\text{s}})t + \frac{1}{2}(-10 \frac{\text{m}}{\text{s}^2})t^2$$

$$(-5 \frac{\text{m}}{\text{s}^2})t^2 + (0.51 \frac{\text{m}}{\text{s}})t + 1.2\text{m} = 0 \text{ (use solver or quadratic) } t = 0.54\text{s}$$

$$\Delta x = v_x \Delta t \Rightarrow \Delta x = 1.4 \frac{\text{m}}{\text{s}} (0.54\text{s}) = 0.76\text{m}$$

2. Now the ramp is tilted downwards and the sphere leaves the ramp at 1.5 m/s as shown below. The bottom of the ramp is 0.90 m above the floor. Calculate the range of the sphere.



$$\Delta y = -0.90 \text{ m}$$

$$v_{yi} = -0.51 \frac{\text{m}}{\text{s}}$$

$$a = g = -10 \frac{\text{m}}{\text{s}^2}$$

$$v_x = 1.45 \frac{\text{m}}{\text{s}}$$

$$\Delta t = ?$$

$$\Delta x = ?$$

$$v_x = \cos 15^\circ (1.5 \frac{\text{m}}{\text{s}}) = 1.45 \frac{\text{m}}{\text{s}}$$

$$v_{yi} = -\sin 15^\circ (1.5 \frac{\text{m}}{\text{s}}) = -0.51 \frac{\text{m}}{\text{s}}$$

$$\Delta y = v_{yi}t + \frac{1}{2}at^2 \Rightarrow -0.90\text{m} = (-0.51 \frac{\text{m}}{\text{s}})t + \frac{1}{2}(-10 \frac{\text{m}}{\text{s}^2})t^2$$

$$(-5 \frac{\text{m}}{\text{s}^2})t^2 + (-0.51 \frac{\text{m}}{\text{s}})t + 0.90\text{m} = 0 \text{ (use solver or quadratic) } t = 0.37\text{s}$$

$$\Delta x = v_x \Delta t \Rightarrow \Delta x = 1.45 \frac{\text{m}}{\text{s}} (0.37\text{s}) = 0.54\text{m}$$

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N Colangelo



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Table of Contents 2d Motion Extra Practice Problems With Answers

1. Understanding the eBook 2d Motion Extra Practice Problems With Answers
 - The Rise of Digital Reading 2d Motion Extra Practice Problems With Answers
 - Advantages of eBooks Over Traditional Books
2. Identifying 2d Motion Extra Practice Problems With 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 2d Motion Extra Practice Problems With Answers
 - User-Friendly Interface
4. Exploring eBook Recommendations from 2d Motion Extra Practice Problems With Answers
 - Personalized Recommendations

- 2d Motion Extra Practice Problems With Answers User Reviews and Ratings
- 2d Motion Extra Practice Problems With Answers and Bestseller Lists
- 5. Accessing 2d Motion Extra Practice Problems With Answers Free and Paid eBooks
 - 2d Motion Extra Practice Problems With Answers Public Domain eBooks
 - 2d Motion Extra Practice Problems With Answers eBook Subscription Services
 - 2d Motion Extra Practice Problems With Answers Budget-Friendly Options
- 6. Navigating 2d Motion Extra Practice Problems With Answers eBook Formats
 - ePub, PDF, MOBI, and More
 - 2d Motion Extra Practice Problems With Answers Compatibility with Devices
 - 2d Motion Extra Practice Problems With Answers Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of 2d Motion Extra Practice Problems With Answers
 - Highlighting and Note-Taking 2d Motion Extra Practice Problems With Answers
 - Interactive Elements 2d Motion Extra Practice Problems With Answers
- 8. Staying Engaged with 2d Motion Extra Practice Problems With Answers
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers 2d Motion Extra Practice Problems With Answers
- 9. Balancing eBooks and Physical Books 2d Motion Extra Practice Problems With Answers
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection 2d Motion Extra Practice Problems With Answers
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine 2d Motion Extra Practice Problems With Answers
 - Setting Reading Goals 2d Motion Extra Practice Problems With Answers
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of 2d Motion Extra Practice Problems With Answers
 - Fact-Checking eBook Content of 2d Motion Extra Practice Problems With 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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