

Uniform Circular Motion: Worksheet 1

Assumes that the car shown below is going at a constant speed.

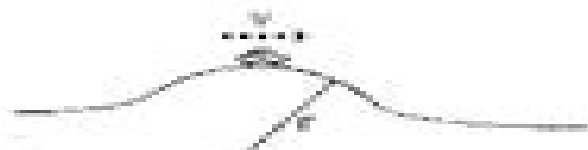


Fig. 1

1. Construct a qualitative motion map of the car in Figure 1.



2. In what direction is the car experiencing acceleration? Explain how you know.

towards the center of the circle
we know it is accelerating bc it is changing direction

3. Construct a force diagram for the car when it's at the top of the hill.



F_g is larger bc that is in

the direction of the acceleration at the top of

4. Suppose the speed of the car is 11.1 m/s (≈ 25 mph) and the radius of curvature (r) is 25 m; determine the magnitude of the centripetal acceleration of the car.

$$a_c = \frac{v^2}{r} = \frac{(11.1 \text{ m/s})^2}{25} = \boxed{4.93 \text{ m/s}^2}$$

5. If the mass of the car is 1200 kg, what F_{net} would be required to cause this centripetal acceleration?

$$F_{\text{net}} = ma_c = (1200 \text{ kg})(4.93 \text{ m/s}^2) = \boxed{5916 \text{ N}}$$

6. Now, determine values for the forces in your force diagram of number 3.

$$\text{In car} = ma_c \Rightarrow F_g - F_N = ma_c \Rightarrow (1200 \text{ kg})(4.93 \text{ m/s}^2) - F_N = (1200 \text{ kg})(4.93 \text{ m/s}^2)$$

$$F_g = (1200 \text{ kg})(9.8 \text{ m/s}^2)$$

$$11760 \text{ N} - F_N = 5916 \text{ N}$$

$$\Rightarrow \begin{cases} F_N = 5844 \text{ N} \\ F_g = 11760 \text{ N} \end{cases}$$

7. At what speed would the centripetal force equal the force of gravity?

$$\text{Set } F_{\text{net}} = F_g \Rightarrow \frac{mv^2}{r} = mg \Rightarrow \frac{v^2}{25} = 9.8 \Rightarrow v^2 = 245 \text{ m/s}^2$$

$$\Rightarrow \boxed{v = 15.65 \text{ m/s}}$$

8. Suppose the car were going faster than the speed that you calculated for question 7; describe what would happen to the car.

It would come off the hill, bc when $mg = \frac{mv^2}{r}$ it means there is no more normal force

Modeling Workshop Project Physics Unit 7 Answers

RJ Alexander



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Table of Contents Modeling Workshop Project Physics Unit 7 Answers

1. Understanding the eBook Modeling Workshop Project Physics Unit 7 Answers
 - The Rise of Digital Reading Modeling Workshop Project Physics Unit 7 Answers
 - Advantages of eBooks Over Traditional Books
2. Identifying Modeling Workshop Project Physics Unit 7 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 Modeling Workshop Project Physics Unit 7 Answers
 - User-Friendly Interface
4. Exploring eBook Recommendations from Modeling Workshop Project Physics Unit 7 Answers
 - Personalized Recommendations
 - Modeling Workshop Project Physics Unit 7 Answers User Reviews and Ratings
 - Modeling Workshop Project Physics Unit 7 Answers and Bestseller Lists

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