

The Ramp (and Friction) PhET Simulation Lab

Introduction:

When an object is dragged across a horizontal surface, the force of friction that must be overcome depends on the normal force as $F_f = \mu F_n$ and the normal

force is given by $F_n = W$. When the surface becomes an inclined plane, the normal force changes and when the normal force changes, so does the friction.

In this lab, you will change the angle of an inclined plane and observe how weight is resolved into its components (F_n and F_{\parallel}) using the basic trig functions. F_{\parallel} is the force parallel to the inclined plane. F_f is assumed to be going down the plane.

kg is a mass. To convert it to a weight you need to multiply it by the force of gravity (g). Gravity is 9.8 m/s^2 . The formula $W = mg$ is weight equals mass times gravity.



The Ramp

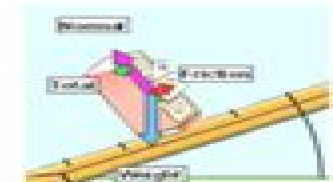
- Be sure to stay in the **Introduction** part of the simulation. *More features* will be used later when we investigate energy. Start by playing with the cabinet some. Have fun, really... Now...back to work.
- Move the cabinet up and down the ramp by dragging it with your mouse.
- Move the ramp to an angle of zero (horizontal) and draw a free body diagram of the cabinet here:

Horizontal plane

1. On a horizontal plane, the normal force is _____ to the weight.
2. The cabinet has a mass of 100kg. It therefore has a normal force of _____ N and a friction force (on the horizontal plane) of _____ $\mu = 0.30$

Inclined plane

- **Reset** the ramp and draw a free body diagram of the cabinet in the box here:
3. Before we add an applied force on the ramp, there is a force of _____ that acts against the force down the plane(Force parallel).
 4. When we apply a force to get the cabinet moving, the friction force acts in the _____ direction as movement of the cabinet.
 5. Slowly increase angle of the ramp until the cabinet starts to move on its own. What angle is this? _____ = θ
 6. At this point, the force down the plane is _____ than the force of friction.
 7. Since the ramp is now at an angle, the normal force is _____ than the weight.
 8. At the angle above, the normal force equals _____ N. (Hint: Trig function)
 9. At the angle above, the force down the plane equals _____ N.
 10. Using the formula for friction above, the force of friction is _____ N.
 11. If the plane-cabinet were frictionless, what angle would be required for the cabinet to move? _____
- Calculate first, then test each object in the table below with the simulation on a horizontal plane.



$$g = 9.8 \text{ m/s}^2$$

The Ramp And Friction Phet Simulation Lab Answer

Tobias Bleicker



The Ramp And Friction Phet Simulation Lab Answer:

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Table of Contents The Ramp And Friction Phet Simulation Lab Answer

1. Understanding the eBook The Ramp And Friction Phet Simulation Lab Answer
 - The Rise of Digital Reading The Ramp And Friction Phet Simulation Lab Answer
 - Advantages of eBooks Over Traditional Books
2. Identifying The Ramp And Friction Phet Simulation Lab Answer
 - 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 The Ramp And Friction Phet Simulation Lab Answer
 - User-Friendly Interface
4. Exploring eBook Recommendations from The Ramp And Friction Phet Simulation Lab Answer
 - Personalized Recommendations
 - The Ramp And Friction Phet Simulation Lab Answer User Reviews and Ratings
 - The Ramp And Friction Phet Simulation Lab Answer and Bestseller Lists
5. Accessing The Ramp And Friction Phet Simulation Lab Answer Free and Paid eBooks
 - The Ramp And Friction Phet Simulation Lab Answer Public Domain eBooks
 - The Ramp And Friction Phet Simulation Lab Answer eBook Subscription Services
 - The Ramp And Friction Phet Simulation Lab Answer Budget-Friendly Options
6. Navigating The Ramp And Friction Phet Simulation Lab Answer eBook Formats

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