

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 $F_n = F_g$. 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 ($F_{n\theta}$ and $F_{g\theta}$) using the basic trig functions.



The Ramp

Procedure: Play with the Sims \Rightarrow Physics \Rightarrow Motion \Rightarrow The Ramp **Run Now!**

• 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:

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 _____ $\mu = 0.30$

• **Reset** the ramp and draw a free body diagram of the cabinet in the box here:

3. The force down the plane and normal force are components of _____.
4. Before we add an applied force on the ramp, there is a force of _____ that acts against the force down the plane(Force parallel).

5. When we apply a force to get the cabinet moving, the friction force acts in the _____ direction as movement of the cabinet.



6. **Slowly** increase angle (0.1 degrees at a time) of the ramp until the cabinet starts to move on its own. What angle is this? _____ = θ

7. At this point, the force down the plane is _____ than the force of friction.

8. Since the ramp is now at an angle, the normal force is _____ than the weight.

9. At the angle above, the normal force equals _____ N. (hint: what trig function?)

10. At the angle above, the force down the plane equals _____ N. (trig function?)

11. Using the formula for friction above, the force of friction is _____ N.

12. If the plane-cabinet were frictionless, what angle would be required for the cabinet to move? _____

13. Why? _____



$g = 9.8m/s^2$

Calculate first, then test each object in the table below with the simulation on a horizontal plane.

Object	Mass	Weight	Normal Force	μ , Coef of Friction	Friction Force to Overcome
Dog				0.10	
Crate				0.70	
Piano				0.40	
Refrigerator				0.50	

Conclusion Calculations:

GRADED

Phet Lab Answers The Ramp

**Malcolm Beaverstock, Bill
Nordgren, Allen Greenwood, Eamonn
Lavery, William Nordgren**

Phet Lab Answers The Ramp

Simulation with Arena W. David Kelton,Randall P. Sadowski,David T. Sturrock,2004 The first edition of this book was the first text to be written on the Arena software which is a very popular simulation modeling software What makes this text the authoritative source on Arena is that it was written by the creators of Arena themselves The new third edition follows in the tradition of the successful first and second editions in its tutorial style via a sequence of carefully crafted examples and an accessible writing style The updates include thorough coverage of the new version of the Arena software Arena 7 01 enhanced support for Excel and Access and updated examples to reflect the new version of software The CD ROM that accompanies the book contains the Academic version of the Arena software The software features new capabilities such as model documentation enhanced plots file reading and writing printing and animation symbols

An Introduction to Reservoir Simulation Using MATLAB/GNU Octave Knut-Andreas Lie,2019-08-08 Presents numerical methods for reservoir simulation with efficient implementation and examples using widely used online open source code for researchers professionals and advanced students This title is also available as Open Access on Cambridge Core

Applied Simulation Malcolm Beaverstock,Bill Nordgren,Allen Greenwood,Eamonn Lavery,William Nordgren,2012-07-15

America's Lab Report National Research Council,Division of Behavioral and Social Sciences and Education,Center for Education,Board on Science Education,Committee on High School Laboratories: Role and Vision,2006-01-20 Laboratory experiences as a part of most U S high school science curricula have been taken for granted for decades but they have rarely been carefully examined What do they contribute to science learning What can they contribute to science learning What is the current status of labs in our nation s high schools as a context for learning science This book looks at a range of questions about how laboratory experiences fit into U S high schools What is effective laboratory teaching What does research tell us about learning in high school science labs How should student learning in laboratory experiences be assessed Do all student have access to laboratory experiences What changes need to be made to improve laboratory experiences for high school students How can school organization contribute to effective laboratory teaching With increased attention to the U S education system and student outcomes no part of the high school curriculum should escape scrutiny This timely book investigates factors that influence a high school laboratory experience looking closely at what currently takes place and what the goals of those experiences are and should be Science educators school administrators policy makers and parents will all benefit from a better understanding of the need for laboratory experiences to be an integral part of the science curriculum and how that can be accomplished

Physics Experiments for Children Muriel Mandell,1968-01-01 Directions for many simple physics experiments including descriptions of necessary equipment principles techniques and safety precautions

APPlusPhysics Dan Fullerton,2011-04-28 APPlusPhysics Your Guide to Regents Physics Essentials is a clear and concise roadmap to the entire New York State Regents Physics curriculum preparing students for success in their high school physics class as well as review for high marks on the Regents Physics Exam Topics covered include pre requisite math and trigonometry kinematics forces Newton s Laws of Motion circular motion and gravity impulse and momentum work energy and power electrostatics electric circuits magnetism waves optics and modern physics Featuring more than five hundred questions from past Regents exams with worked out solutions and detailed illustrations this book is integrated with the APPlusPhysics com website which includes online question and answer forums videos animations and supplemental problems to help you master Regents Physics essentials The best physics books are the ones kids will actually read Advance Praise for APPlusPhysics Regents Physics Essentials Very well written simple clear engaging and accessible You hit a grand slam with this review book Anthony NY Regents Physics Teacher Does a great job giving students what they need to know The value provided is amazing Tom NY Regents Physics Teacher This was tremendous preparation for my physics test I love the detailed problem solutions Jenny NY Regents Physics Student Regents Physics Essentials has all the information you could ever need and is much easier to understand than many other textbooks it is an excellent review tool and is truly written for students Cat NY Regents Physics Student

Software-Defined Radio for Engineers Alexander M. Wyglinski,Robin Getz,Travis Collins,Di Pu,2018-04-30 Based on the popular Artech House classic Digital Communication Systems Engineering with Software Defined Radio this book provides a practical approach to quickly learning the software defined radio SDR concepts needed for work in the field This up to date volume guides readers on how to quickly prototype wireless designs using SDR for real world testing and experimentation This book explores advanced wireless communication techniques such as OFDM LTE WLA and hardware targeting Readers will gain an understanding of the core concepts behind wireless hardware such as the radio frequency front end analog to digital and digital to analog converters as well as various processing technologies Moreover this volume includes chapters on timing estimation matched filtering frame synchronization message decoding and source coding The orthogonal frequency division multiplexing is explained and details about HDL code generation and deployment are provided The book concludes with coverage of the WLAN toolbox with OFDM beacon reception and the LTE toolbox with downlink reception Multiple case studies are provided throughout the book Both MATLAB and Simulink source code are included to assist readers with their projects in the field

College Physics for AP® Courses Irna Lyublinskaya,Douglas Ingram,Gregg Wolfe,Roger Hinrichs,Kim Dirks,Liza Pujji,Manjula Devi Sharma,Sudhi Oberoi,Nathan Czuba,Julie Kretchman,John Stoke,David Anderson,Erika Gasper,2015-07-31 This introductory algebra based two semester college physics book is grounded with real world examples illustrations and explanations to help students grasp key fundamental physics concepts This online fully editable and customizable title includes learning objectives concept questions links to labs and simulations and ample practice opportunities to solve traditional physics application problems Website of book

The Principles of Quantum Mechanics Paul Adrien Maurice Dirac,1981 The first edition of this work appeared in 1930 and its originality won it immediate recognition as a classic of modern physical theory The fourth edition has been bought out to meet a continued demand Some improvements have been made the main one being the complete rewriting of the chapter on quantum electrodymanics to bring in electron pair creation This makes it suitable as an introduction to recent works on quantum field theories

Energy Roger Hinrichs,Merlin H. Kleinbach,2013 What is the impact of such energy issues as global warming radioactive waste and municipal solid waste on the individual and society ENERGY ITS USES AND THE ENVIRONMENT 5E International Edition answers these questions emphasizing the physical principles behind energy and its effects on our environment and explaining the basic physical principles behind the use of energy including the study of mechanics electricity and magnetism thermodynamics and atomic and nuclear physics By placing energy issues within the context of everyday examples and asking you to define and support critical arguments ENERGY ITS USES AND THE ENVIRONMENT 5E International Edition offers a provocative approach to this crucial issue

European Guide to Power System Testing Thomas I. Strasser,Erik C. W. de Jong,Maria Sosnina,2020-06-11 This book is an open access book This book provides an overview of the ERIGrid validation methodology for validating CPES a holistic power system testing method It introduces readers to corresponding simulation and laboratory based tools including co simulation real time simulation and hardware in the loop Selected test cases and validation examples are provided in order to support the theory discussed The book begins with an introduction to current power system testing methods and an overview of the ERIGrid system level validation approach It then moves on to discuss various validation methods concepts and tools including simulation and laboratory based assessment methods The book presents test cases and validation examples of the proposed methodologies and summarises the lessons learned from the holistic validation approach In the final section of the book the educational aspects of these methods the outlook for the future and overall conclusions are discussed Given its scope the book will be of interest to researchers engineers and laboratory personnel in the fields of power systems and smart grids as well as undergraduate and graduate students studying related engineering topics

Physical Science Two Newton College of the Sacred Heart,1972

University Physics Samuel J. Ling,Jeff Sanny,William Moebs,2017-12-19 University Physics is designed for the two or three semester calculus based physics course The text has been developed to meet the scope and sequence of most university physics courses and provides a foundation for a career in mathematics science or engineering The book provides an important opportunity for students to learn the core concepts of physics and understand how those concepts apply to their lives and to the world around them Due to the comprehensive nature of the material we are offering the book in three volumes for flexibility and efficiency Coverage and Scope Our University Physics textbook adheres to the scope and sequence of most two and three semester physics courses nationwide We have worked to make physics interesting and accessible to students while maintaining the mathematical rigor inherent in the subject With this objective in mind the content of this textbook has been developed and arranged to provide a logical progression from fundamental to more advanced concepts building upon what students have already learned and emphasizing connections between topics and between theory and applications The goal of each section is to enable students not just to recognize concepts but to work with them in ways that will be useful in later courses and future careers The organization and pedagogical features were developed and vetted with feedback from science educators dedicated to the project VOLUME I Unit 1 Mechanics Chapter 1 Units and Measurement Chapter 2 Vectors Chapter 3 Motion Along a Straight Line Chapter 4 Motion in Two and Three Dimensions Chapter 5 Newton s Laws of Motion Chapter 6 Applications of Newton s Laws Chapter 7 Work and Kinetic Energy Chapter 8 Potential Energy and Conservation of Energy Chapter 9 Linear Momentum and Collisions Chapter 10 Fixed Axis Rotation Chapter 11 Angular Momentum Chapter 12 Static Equilibrium and Elasticity Chapter 13 Gravitation Chapter 14 Fluid Mechanics Unit 2 Waves and Acoustics Chapter 15 Oscillations Chapter 16 Waves Chapter 17 Sound

Space Simulation ,1972 Space simulation conference

TIPERs C. J. Hieggelke, D. P. Maloney, Stephen E. Kanim, Thomas L. O'Kuma, 2013-12-17 TIPERs Sensemaking Tasks for Introductory Physics gives introductory physics students the type of practice they need to promote a conceptual understanding of problem solving This supplementary text helps students to connect the physical rules of the universe with the mathematical tools used to express them The exercises in this workbook are intended to promote sensemaking The various formats of the questions are difficult to solve just by using physics equations as formulas Students will need to develop a solid qualitative understanding of the concepts principles and relationships in physics In addition they will have to decide what is relevant and what isn't which equations apply and which don't and what the equations tell one about physical situations The goal is that when students are given a physics problem where they are asked solve for an unknown quantity they will understand the physics of the problem in addition to finding the answer

Physlets Wolfgang Christian, Mario Belloni, 2001 This manual CD package shows physics instructors both web novices and Java savvy programmers alike how to author their own interactive curricular material using Physlets Java applets written for physics pedagogy that can be embedded directly into html documents and that can interact with the user It demonstrates the use of Physlets in conjunction with JavaScript to deliver a wide variety of web based interactive physics activities and provides examples of Physlets created for classroom demonstrations traditional and Just in Time Teaching homework problems pre and post laboratory exercises and Interactive Engagement activities More than just a technical how to book the manual gives instructors some ideas about the new possibilities that Physlets offer and is designed to make the transition to using Physlets quick and easy Covers Pedagogy and Technology JITT and Physlets PER and Physlets technology overview and scripting tutorial Curricular Material in class activities mechanics waves and thermodynamics problems electromagnetism and optics problems and modern physics problems and References on resources inherited methods naming conventions Animator EFIELD DATAGRAPH DATATABLE Version Four Physlets For Physics instructors

Physics for Scientists and Engineers Raymond Serway, John Jewett, 2013-01-01 As a market leader PHYSICS FOR SCIENTISTS AND ENGINEERS is one of the most powerful brands in the physics market While preserving concise language state of the art educational pedagogy and top notch worked examples the Ninth Edition highlights the Analysis Model approach to problem solving including brand new Analysis Model Tutorials written by text co author John Jewett and available in Enhanced WebAssign The Analysis Model approach lays out a standard set of situations that appear in most physics problems and serves as a bridge to help students identify the correct fundamental principle and then the equation to utilize in solving that problem The unified art program and the carefully thought out problem sets also enhance the thoughtful instruction for which Raymond A Serway and John W Jewett Jr earned their reputations The Ninth Edition of PHYSICS FOR SCIENTISTS AND ENGINEERS continues to be accompanied by Enhanced WebAssign in the most integrated text technology offering available today Important Notice Media content referenced within the product description or the product text may not be available in the ebook version

The Future of Making Tom Wujec,2017 Prepare yourself How things are made is changing The digital and physical are uniting from innovative methods to sense and understand our world to machines that learn and design in ways no human ever could from 3D printing to materials with properties that literally stretch possibility from objects that evolve to systems that police themselves The results will radically change our world and ourselves The Future of Making illustrates these transformations showcasing stories and images of people and ideas at the forefront of this radical wave of innovation Designers architects builders thought leaders creators of all kinds have contributed to this look at the materials connections and inventions that will define tomorrow But this book doesn t just catalog the future it lays down guidelines to follow new rules for how things are created that make it the ultimate handbook for anyone who wants to embrace the true future of making

Drug Information Handbook Charles F. Lacy,Lora L. Armstrong,Morton P. Goldman,2003

Stockley's Drug Interactions Karen Baxter,2010 Stockley s Drug Interactions now fully revised and revalidated remains the world s most comprehensive and authoritative reference book on drug interactions and provides the busy healthcare professional with quick and easy access to clinically relevant evaluated and evidence based information on drug interactions Contains detailed yet concise monographs covers interactions between therapeutic drugs proprietary medicines herbal medicines foods drinks pesticides and drugs of abuse based on published sources and fully referenced provides comprehensive details of the clinical evidence for the interactions under discussion an assessment of their clinical importance and gives clear guidance on how to manage the interaction in practice contains over 3 400 monographs New drugs launched in the last two years added including drugs such as fesoterodine several monoclonal antibodies new antidiabetics e g sitagliptin new antineoplastics e g dasatinib and new immunosuppressants e g temsirolimus updated information on seasonal flu vaccines and antivirals including all available information on possible interactions with concurrent medication increased commentary on the involvement of newer mechanisms in drug interactions such as drug transporter proteins and other genetic factors that affect the ability of individuals to metabolise medicines

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