PHYSICS 110A : CLASSICAL MECHANICS PROBLEM SET #4

[1] Consider the mechanical thingy in Fig. 1. Two masses m are connected to the central axis and to a third mass M by massless rigid rods of length ℓ, as shown. The mass M slides frictionlessly along the axis. There is one degree of freedom, which is the angle θ, also shown. The thingy is rotated about its symmetry axis with angular velocity ω.

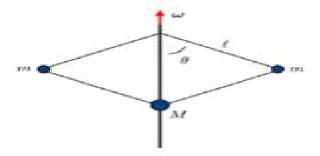


Figure 1: The thingy.

(a) Find the Lagrangian for the thingy.

(b) Find the equation of motion.

(c) Show that there is one stable equilibrium when ω is small. Find the equilibrium point and find the frequency of small oscillations about this equilibrium.

(d) Show that for ω > ω_c the stable equilibrium shifts to a nonzero value of θ. Find the location of the new equilibrium and compute the corresponding frequency of small oscillations.

(e) Identify any and all conserved quantities.

[2] A mechanical system is described by the Lagrangian

$$L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2 + \dot{x}^2) + \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2) - V(x + ky + lz, y + a\phi), \qquad (1)$$

where k, l, and a are constants.

(a) How many independent one-parameter families of transformations leave L invariant?

(b) For each continuous symmetry, identify the associated conserved quantity.

(c) Are there any other conserved quantities? Find an expression for any other conserved quantities which may exist.

Classical Mechanics Problem Solutions

David J. Morin

Classical Mechanics Problem Solutions:

Classical Mechanics Konstantin Konstantinovich Likharev, 2017 Essential Advanced Physics is a series comprising four parts Classical Mechanics Classical Electrodynamics Quantum Mechanics and Statistical Mechanics Each part consists of two volumes Lecture notes and Problems with solutions further supplemented by an additional collection of test problems and solutions available to qualifying university instructors This volume Classical Mechanics Problems with solutions contains detailed model solutions to the exercise problems formulated in the companion Lecture notes volume In many cases the solutions include result discussions that enhance the lecture material For the reader s convenience the problem assignments are reproduced in this volume Source r sum de l diteur Analytical Mechanics Ioan Merches, Daniel Radu, 2014-08-26 Giving students a thorough grounding in basic problems and their solutions Analytical Mechanics Solutions to Problems in Classical Physics presents a short theoretical description of the principles and methods of analytical mechanics followed by solved problems The authors thoroughly discuss solutions to the problems by taking a comprehensive approach to explore the methods of investigation They carefully perform the calculations step by step graphically displaying some solutions via Mathematica 4 0 This collection of solved problems gives students experience in applying theory Lagrangian and Hamiltonian formalisms for discrete and continuous systems Hamilton Jacobi method variational calculus theory of stability and more to problems in classical physics The authors develop some theoretical subjects so that students can follow solutions to the problems without appealing to other reference sources This has been done for both discrete and continuous physical systems or in analytical terms systems with finite and infinite degrees of freedom The authors also highlight the basics of vector algebra and vector analysis in Appendix B They thoroughly develop and discuss notions like gradient divergence curl and tensor together with their physical applications. There are many excellent textbooks dedicated to applied analytical mechanics for both students and their instructors but this one takes an unusual approach with a thorough analysis of solutions to the problems and an appropriate choice of applications in various branches of physics It lays out the similarities and differences between various analytical approaches and their specific efficiency Solved Problems in Classical Mechanics O. L. de Lange, J. Pierrus, 2010-05-06 Apart from an introductory chapter giving a brief summary of Newtonian and Lagrangian mechanics this book consists entirely of questions and solutions on topics in classical mechanics that will be encountered in undergraduate and graduate courses These include one two and three dimensional motion linear and nonlinear oscillations energy potentials momentum and angular momentum spherically symmetric potentials multi particle systems rigid bodies translation and rotation of the reference frame the relativity principle and some of its consequences The solutions are followed by a set of comments intended to stimulate inductive reasoning and provide additional information of interest Both analytical and numerical computer techniques are used to obtain and analyze solutions The computer calculations use Mathematica version 7 and the relevant code is given in the text It includes use of the interactive Manipulate function which enables one to observe simulated motion on a computer screen and to study the effects of changing parameters The book will be useful to students and lecturers in undergraduate and graduate courses on classical mechanics Classical Mechanics Carolina C. Ilie, Zachariah S. and students and lecturers in courses in computational physics Schrecengost, Elina M. van Kempen, 2022-12-29 This book of problems and solutions in classical mechanics is dedicated to junior or senior undergraduate students in physics engineering applied mathematics astronomy or chemistry who may want to improve their problems solving skills or to freshman graduate students who may be seeking a refresh of the material The book is structured in ten chapters starting with Newton's laws motion with air resistance conservation laws oscillations and the Lagrangian and Hamiltonian Formalisms The last two chapters introduce some ideas in nonlinear dynamics chaos and special relativity Each chapter starts with a brief theoretical outline and continues with problems and detailed solutions A concise presentation of differential equations can be found in the appendix A variety of problems are presented from the standard classical mechanics problems to context rich problems and more challenging problems Key features Presents a theoretical outline for each chapter Motivates the students with standard mechanics problems with step by step explanations Challenges the students with more complex problems with detailed solutions Essential Classical Mechanics: Problems And Solutions Choonkyu Lee, Hyunsoo Min, 2018-07-10 The authors of this book offer a very strong reason for the study of classical mechanics describing it as the base on which the whole pyramid of modern physics has been erected In order that students can gauge their understanding of the various topics many exercises are introduced Some of those should be straightforward whilst others are quite challenging The authors are to be thanked for delivering a highly readable text which should assure a continued supply of practitioners of classical mechanics and its applications Contemporary PhysicsProblem solving in physics is not simply a test of understanding but an integral part of learning This book contains complete step by step solutions for all exercise problems in Essential Classical Mechanics with succinct chapter by chapter summaries of key concepts and formulas The degree of difficulty with problems varies from quite simple to very challenging but none too easy as all problems in physics demand some subtlety of intuition The emphasis of the book is not so much in acquainting students with various problem solving techniques as in suggesting ways of thinking For undergraduate and graduate students as well as those involved in teaching classical mechanics this book can be used as a supplementary text or as an independent study Cognitive Structures in Scientific Inquiry Roberto **Introduction to Classical Mechanics** David Morin, 2008 aid Festa, Atocha Aliseda, Adriana Johanna Maria Peijnenburg, 2005 This book is the first of two volumes devoted to the work of Theo Kuipers a leading Dutch philosopher of science Philosophers and scientists from all over the world thirty seven in all comment on Kuipers philosophy and each of their commentaries is followed by a reply from Kuipers The present volume focuses on Kuipers views on confirmation empirical progress and truth approximation as laid down in his From Instrumentalism to Constructive Realism Kluwer 2000 In this book Kuipers offered a synthesis of Carnap s and Hempel s

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Hydrostatics Sir Alfred William Flux, 1891 Variational Methods and Periodic Solutions of Newtonian N-body **Problems** Kuo-Chang Chen, 2001 Thinking Across Cultures Donald M. Topping, Doris C. Crowell, Victor N. Kobayashi, 2013-09-05 This volume compares and contrasts contemporary theories of cognition modes of perception and learning from cross cultural perspectives. The participants were asked to consider and assess the question of whether people from different cultures think differently Moreover they were asked to consider whether the same approaches to teaching and development of thinking will work in all cultures as well as they do in Western literate societies **Introduction to** Classical Mechanics David J. Morin, 2008 It contains more than 250 problems with detailed solutions so students can easily check their understanding of the topic There are also over 350 unworked exercises which are ideal for homework assignments The vast number of problems alone makes it an ideal supplementary book for all levels of undergraduate physics courses in classical mechanics. The text also includes many additional remarks which discuss issues that are often glossed over in other textbooks and it is thoroughly illustrated with more than 600 figures to help demonstrate key concepts Jacket Solutions of Weekly Problem Papers John James Milne, 1885 Collected Papers on Wave Mechanics Erwin Schrödinger,1928 Solutions [by sir A. W. Flux] of examples in Elementary hydrostatics, by W. H. Besant sir Alfred William Flux,1891 Proceedings of the ... International Workshop on Machine Learning ,1985 **Proceedings** Physical Society (Great Britain), 1927

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