

PHYS 410 Homework # 8

6.1. On a spherical surface, the longitude and latitude lines are orthogonal.



For a small change in position, we have the change in longitude and latitude:

$$ds_{\phi} = R \cdot d\theta, \quad ds_{\lambda} = R \sin\theta \cdot d\phi$$

$$\Rightarrow ds = \sqrt{ds_{\phi}^2 + ds_{\lambda}^2} = R \cdot d\theta \sqrt{1 + \sin^2\theta \frac{d\phi^2}{d\theta^2}}$$

$$\Rightarrow L = \int_R ds = R \int_{\theta_1}^{\theta_2} \sqrt{1 + \sin^2\theta \frac{d\phi^2}{d\theta^2}} \cdot d\theta$$

6.3



$$L(P, Q) = \sqrt{x_1^2 + y_1^2 + z_1^2} + \sqrt{x_2^2 + y_2^2 + z_2^2}$$

$$\Rightarrow T = L/c$$

According to Fermat's principle, we get:

$$\frac{\delta T}{\delta x} = 0, \quad \frac{\delta T}{\delta y} = 0.$$

$$\frac{\delta T}{\delta z} = 0 \Rightarrow 2 \cdot \left(\frac{1}{\sqrt{x_1^2 + y_1^2 + z_1^2}} + \frac{1}{\sqrt{x_2^2 + y_2^2 + z_2^2}} \right) = 0 \Rightarrow z = 0 \quad (1)$$

$$\frac{\delta T}{\delta x} = 0 \Rightarrow \frac{x_1}{\sqrt{x_1^2 + y_1^2 + z_1^2}} + \frac{x_2}{\sqrt{x_2^2 + y_2^2 + z_2^2}} = 0 \quad (2)$$



According to (1), when $z=0$, we get from (2):

$$\sin\theta_1 = \sin\theta_2$$

$$\Rightarrow \theta_1 = \theta_2$$

6.5



According to General Geometric relation, we know $\angle APB = \frac{\theta}{2}$.

$$\text{And } \alpha = \frac{\theta - \theta}{2}$$

$$\Rightarrow AP = AB \cdot \sin(\frac{\theta}{2} - \alpha) = AB \cos \frac{\theta}{2} = AB \sin \frac{\theta}{2} = 2R \sin \frac{\theta}{2}$$

$$BP = AB \cdot \sin \alpha = 2R \cdot \cos \frac{\theta}{2}$$

$$\Rightarrow APB = 2R \cdot (\sin \frac{\theta}{2} + \cos \frac{\theta}{2}) = 2\sqrt{2} \sin(\frac{\theta}{2} + \frac{\pi}{4}) R$$

$$\Rightarrow (APB)_{max} = 2\sqrt{2} R \text{ when } \theta = \frac{\pi}{2}, \text{ which is the real path.}$$

6.7

(2.4.2)



In cylinder coordinates, when R is const, the infinitesimal change in position corresponds to

$$ds = \sqrt{R^2 d\phi^2 + dz^2} = dz \sqrt{1 + R^2 \frac{d\phi^2}{dz^2}} = f(\phi, z) dz$$

$$\Rightarrow L = \int_R ds = \int_{z_1}^{z_2} f(\phi, z) dz$$

Classical Mechanics Problem Solutions

Erwin Schrödinger



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Classical Mechanics Konstantin K. Likharev, 2018-04-30 Essential Advanced Physics EAP 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 Written for graduate and advanced undergraduate students the goal of this series is to provide readers with a knowledge base necessary for professional work in physics be that theoretical or experimental fundamental or applied research From the formal point of view it satisfies typical PhD basic course requirements at major universities Selected parts of the series may also be valuable for graduate students and researchers in allied disciplines including astronomy chemistry materials science and mechanical electrical computer and electronic engineering The EAP series is focused on the development of problem solving skills The following features distinguish it from other graduate level textbooks Concise lecture notes 250 pages per semester Emphasis on simple explanations of the main concepts ideas and phenomena of physics Sets of exercise problems with detailed model solutions in separate companion volumes Extensive cross referencing between the volumes united by common style and notation Additional sets of test problems freely available to qualifying faculty 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

Classical Mechanics Carolina C. Ilie, Zachariah S. 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 Choonkyu Lee, Hyunsoo Min, 2018-04-17 The authors deliver a highly readable text which should assure a continued supply of practitioners of classical mechanics and its applications Contemporary Physics This is a book on intermediate classical mechanics In this book classical mechanics is presented as a useful tool to analyze the physical universe and also as the base on which the whole

pyramid of modern physics has been erected Various mechanical concepts are developed in a highly logical manner with relatively thorough treatments on mathematical procedures and many physically interesting applications Connections to more modern theoretical developments including statistical physics relativity and quantum mechanics are emphasized

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 and students and lecturers in courses in computational physics

Solution Manual For Classical Mechanics And Electrodynamics (Second Edition). Jon Magne Leinaas, 2025

Introduction To Classical Mechanics: Solutions To Problems John Dirk Walecka, 2020-08-24 The textbook Introduction to Classical Mechanics aims to provide a clear and concise set of lectures that take one from the introduction and application of Newton's laws up to Hamilton's principle of stationary action and the Lagrangian mechanics of continuous systems An extensive set of accessible problems enhances and extends the coverage It serves as a prequel to the author's recently published book entitled Introduction to Electricity and Magnetism based on an introductory course taught some time ago at Stanford with over 400 students enrolled Both lectures assume a good concurrent course in calculus and familiarity with basic concepts in physics the development is otherwise self contained As an aid for teaching and learning and as was previously done with the publication of Introduction to Electricity and Magnetism Solutions to Problems this additional book provides the solutions to the problems in the text Introduction to Classical Mechanics

The Mechanics Problem Solver Research and Education Association, 1995

Cognitive Structures in Scientific Inquiry, 2016-08-01 This book is the second 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 is devoted to Kuipers neo classical philosophy of science as laid down in his Structures in Science Kluwer 2001 Kuipers defends a dialectical interaction between science and philosophy in that he views philosophy of science as a meta science which formulates cognitive structures that provide heuristic patterns for actual scientific research including design

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