

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:

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

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

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

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:

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

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

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



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

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

$$\Rightarrow L = \int_R ds = \int_{\phi_1}^{\phi_2} f(\phi, z) dz$$

# Classical Mechanics Problem Solutions

**Roberto Festa, Atocha Aliseda, Adriana  
Johanna Maria Peijnenburg**

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**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

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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* Roberto 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 confirmation theory on the one hand and Popper's theory of truth approximation on the other The key element of this synthesis is a sophisticated methodology which enables the evaluation of theories in terms of their problems and successes even if the theories are already falsified and which also fits well with the claim that one theory is closer to the truth than another Ilkka Niiniluoto Patrick Maher John Welch Gerhard Schurz Igor Douven Bert Hamminga David Miller Johan van Benthem Sjoerd Zwart Thomas Mormann Jes's Zamora Bonilla Isabella Burger andamp Johannes Heidema Joke Meheus Hans Mooij and Diderik Batens comment on these ideas of Kuipers and many present their own account The present book also contains a synopsis of *From Instrumentalism to Constructive Realism* It can be read independently of the second volume of *Essays in Debate with Theo Kuipers* which is devoted to Kuipers *Structures in Science* 2001 *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 Physics Problem 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 aid

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**Collected Papers on Wave Mechanics** Erwin Schrödinger, 1928

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