Rindler relativity solution manual

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Disclaimer: These are decisions prepared by Jacob Burjaili for coursework done at Princeton University in the fall of 2006. They are only for academic use. They should only be used as a reference. Please don't copy the solutions and present them as your own. I don't guarantee they're correct, but if errors are found, I'd appreciate the notification via email. They are not sanctioned by either the author (s) of the relevant textbooks, nor the professors who appropriated them to me. These decisions reflect the assignments made by Professor Igor Klebanov at Princeton University during his semester course in general relativity in the fall of 2006. The course started relatively slowly, and took the pace towards the end. Homework reflects that. The main course textbook was Bernard Schutz's first course in general relativity, and some of the homework came from the text. All Decisions Lecturer: Masood Haq (haque@thphys.nuim.ie) Teacher Aonghus Hunter-McCabe (Aonghus.HunterMccabe@mu.ie). The final exam, Thursday 28 May 2020 Here is the final exam on May 28, available after 2:15 p.m. A set of problems set problems 11. Because of Thursday, May 7. Partial solutions/hints for problem set 11. A set of problems 10. Because of Tuesday, April 28. Partial solutions/hints for a set of problems 10. Problem set 09. Because of Tuesday 21 April, after the Easter holidays. Partial solutions/hints for problem dial 09. Problem set 08. Because of Tuesday, April 7. Partial solutions/hints for problem dial 08. Problem set 07. Because of Tuesday, March 31. Partial solutions/hints for problem dial 07. Problem set 06. It was due to take place on Tuesday, 24 March; extended until Thursday 26 March. To scan and download as a PDF file. For the study break: twice as many as the usual weekly problems. Partial solutions/hints for problem dial 06. Problem set 05. Because of Tuesday, March 10. Problem set 04. Because of Monday, March 2. Partial solutions/hints for problem dial 04. The textbook (where this set of problems was to be discussed) was replaced by a lecture; So I'm posting some solutions. Problem set 03. Because of Monday, February 24. Problem set 02. Because of Monday, February 17. Problem set 01. Because of Monday, February 10. Practice Bank Problems ('problem set 12') Is flagged as Problem Set 12, but it's a really large collection of problems covering all module material. Should be useful for practicing the material/concept of the entire module as well as for preparing for the exam. Notes on Index/Tensor notes Here are my on typical notes, inputd by tensor and tensor notation (index notation). Electromagnetism in relativistic notation We missed lectures on April 28 and May 1 because of my illness. During this period of time, the plan was to cover electromagnetism in tensor notation, and relativistic effects in electromagnetism. Please find out this stuff from 5.2, 5.3, 5.4 of these Tonga lectures. That's quite a lot of stuff. The main topics you should pick up from here are: (1) electromagnetic field tensor, (F'muu). How is Fmu defined in terms of a potential 4-vector (AMU)? What are the 16 Fmuu elements) How many independent items exist? (2) How Maxwell's equations are written in terms of q (F'muu), in tensor notation. (3) How gauge transformations are written in tensor notation. (4) As the law of power Lorentz is written in tensor notation, as an equation relating to 4-strength and 4-speed with q (F'muu). (5) How the continuity equation is written in tensor notation. 'Virtual Lecture' on Friday April 24Th In this lecture, we will certify our study of the Lorenz group by adding material about the rotation group and the Poincare group. Here are the updated group notes. Previous material about Lorenz's bands is in section 2 of this record, and has also been slightly expanded. When you work through this writeup, you should also receive a Tuesday material review. Virtual Lecture on Tuesday April 21 In this lecture, we begin with the group Lorenz and its structure. Here are the notes starting the study of lorenz groups. As usual, I am very grateful to those who point out typos for me. If you notice any errors, please let me know! As an additional reading, you can try pages 10-17 of these notes that enter the metric tenor and lorenz group. The first few pages (5-9) introduce index notation, which would also be a good idea to consider. up to page 7 of these notes discussing the rotation group and Lorenz's group. 'Virtual Lecture' on Tuesday April 7Ths. I have used this notation sometimes in previous lectures. It will become a standard language later, so let's get used to it! The index notation is summarized in section 5.1 of these Tonga lectures. In particular, please read Subsections 5.1.3 and 5.1.4. (Of course you would benefit from reading the first two subsections as well.) The notation is very similar to what we used, except that it uses instead of eta_ (g_ mou). Both notations are common. For additional reading, here's roughly equivalent material: -- Sections 5.5 and 5.6 of these notes. Virtual Lecture on Friday April 3Th lecture will be light on new material. I suggest first to consider the material in previous virtual lectures. I've updated notes that describe several 4-vectors. The new part is in the last two subsections (the last 3/1/2 pages). Two new 4-vectors have been added: 4-potential and 4-current. They are no longer related to the kinematics/dynamics of the point object. Instead, they combine objects that you've learned about in electromagnetism. 'Virtual Lecture' on Tuesday 31 March In this we will continue to study four vectors: (1) We will learn what it means for a 4-vector to be like time, cosmic or light; (2) We will present several physical 4-vectors. Here are notes describing the time as /space as / null 4-vectors. Here are the notes describing several 4-vectors. As usual, I am very grateful to those who point out typos for me. If you notice any errors, please let me know! In this lecture we focus on 4 vectors related to the movement of an object or particle. In the next lecture we will continue to meet with several other 4-vectors. This material is very standard, but the notation varies greatly. I hope I gave enough hints about the various notation that you should be able to read another source with reasonable comfort. For additional reading, I can suggest the Wikipedia page listed on this page, the Wikipedia page on Lorentz scalars, this page on the 4-speed and 4-speed that actually puts time as the 4th dimension, not the 0th, section 1 (1.1 to 1.5) of this page scholarpedia. Virtual Lecture on Friday 27 March In this lecture we will present four-vector. First, please review the last page of the notes for the Lecture on March 23. There we explained the need for 4-vector objects, --- are transformed as coordinates or intervals of space-time. We also know two examples of 4-vectors already: (1) coordinates/space-time intervals and (2) 4-moment or energy impulse. For this lecture: Here are my print notes for the lecture on March 27. First (section 1) we are reviewing our understanding of what vectors and scalars actually mean in conventional (Euclidean) mechanics. Thus, prepared, we are ready to introduce 4-vectors, and some of their properties (section 2). As usual, if you notice any typographical or other errors, please let me know. A big thank you to those who noticed errors in the notes of March 23 and pointed them out to me. In addition to my notes, you can read sections 6.1, 6.2, 6.3, 6.4 of these notes. In the following lectures we will build/list various physical 4-vectors (4-speed, 4-strength, density-current density, 4-potential in electromagnetism, etc.). We will also introduce index notation for 4 vectors and their internal products. Virtual Lecture on Tuesday 23 March For this lecture, we want (1) review and expand expressions of energy and momentum; (2) Introduce mass-less particles or photons; (3) Take a look at the power of relativity; (4) Figure out the conversion of energy and momentum under the impulse. Points (2) and (3) above indicate the need to introduce 4-vectors, which we will do in the next lecture. Here are the notes for the March 23 lecture. (If you notice any typographical or other errors, please let me know.) Review: Pulse and Energy Sections 1 4 reviews some of what we learned about momentum and energy, with some some I'm not sure if I introduced Eq. (5) Already? It's an important equation. Please take him out of Eqs. Section 4 is a longer discussion of the collision that we considered in the class before the stop. You'll have to work on more complex collisions in the coming weeks, so I suggest working through this simple clash in detail. For example, write down the momentum preservation equations and the energy saving equations in both frames. Amazing photon Section 5 about the thoughtless particles that move at the speed of light: photons. He argues how relativistic equations allow for meaningful appropriation of moments and energy to zero-mass particles! Subsection 5.1 is the practice of things you have learned. The power of Section 6 shows and displays expressions of power in a particular theory of relativity. It's an ugly expression!! Transforming energy and impulse Given the increase, we learn that energy and momentum together are transformed in the same way as time and position. It motivates 4-vectors, for Friday's class. ... Continuous evaluation and purpose of problem plan sets is to assign one problem set each week. They will be posted on this web page. The assignments will be due Monday, in a box marked 352 near the front door of the Department of Theoretical Physics. We won't be able to mark all the appointments. We will not announce in advance which assignments should be marked, so it will be in your favor to submit each assignment. The destination marks (continuous assessment) will be counted to the final mark of the module only if they are in favor of the students. (The policy depends on the modules and varies in the department of mathematical physics. HOWEVER: Don't think of jobs as voluntary or optional. Without working on each set of tasks, you'll probably get lost quickly, as the module will rely on tasks and assume that you've learned the material you need to learn by identifying the assignments. Notes/handouts Here are some derivatives of Lorenz's conversions for standard enhancement. If you notice any typos or errors, please let me know. Material, sources Special Theory of Relativity defies our intuition and requires effort to digest; so I highly recommend trying to read a fair bit every week. For example, you might want to work through two sections of Nash notes (see below) each week, or a similar amount of work from another text. Nash notes: lecture notes by Professor Charles Nash, who taught MP352 a few years ago This has some overlap with the material currently covered in MP352. Unfortunately, the order is different. Textbooks: There are many textbooks covering the special theory of relativity. the library carries a number of these textbooks. Special relativity is also covered in many textbooks on classical mechanics or or and is often summarized at the beginning of texts about general relativity or particle physics. I list the selection below. (I omit the publisher and the publication date; should be easy enough to find.) See, Einstein Gravity in a Nutshell This book is aimed at the general theory of relativity, but on the way (in Part III) examines a special theory of relativity in detail. Great pleasure to read. Chapter 11 -- 13 of: Maureen, Introduction to Classical Mechanics Very Careful Treatment. Great challenges and exercises. Covers more than half or so of what we will do in this module. A chapter on relativity in: Griffiths, Introduction to Electrodynamics Very Clear and Physical Treatment. (Relativity in Chapter 10 in the old edition I have; the chapter number varies depending on the publication.) Chapter 12 - 14: Kleppner and Kolenkov, Introduction to Mechanics, 2nd. Covers maybe a more basic one-third or so of what we do in this module. The level is intermediate between the Resnick-Holliday level and the level of this module. The university library has several copies of the book. Chapter 15 -- 17 of: Feynman's Lectures on Physics, Volume I Classics. Free to read online, on this site. A few outdated terminology/conventions, but should still be read. Covers more basic one-third or so of what we do in this module. Cheng, Relativity, Gravity and Cosmology Special Theory of Relativity is seen as a prerequisite for general relativity. Very clear treatment. Special theory of relativity is considered in Chapter 2 in the 1st edition, but is broken down into chapters 2 and 3 in the 2nd edition. Chapter 1: Landau and Lifshitz, Classical Field Theory This is Volume 2 of the famous Course of Theoretical Physics. Chapter 7: Goldstein, Classic Mechanics Brief Treatment of some of the more advanced aspects. Chapter 1 - 4 (and bits of chapters 5.6) from: Woodhouse, Special Theory of Relativity More Mathematical. Chapters 1 - 5 of: Rindler, Relativity: Special, General and Cosmological Chapters 29 - 34 of: Greiner, Classical Mechanics: Point Particles and Relativity Bais, Very Special Theory of Relativity: Illustrated Guide Very Special and Worth Reading. Avoids formalism and teaches through photography (through carefully analyzed space-time diagrams). Steane, relatively easily This tutorial covers most of the material that will be covered in this module. A chapter on relativity's: Jackson, Classical Electrodynamics Brief processing of some of the more advanced aspects. Material available online: Please let me know if any of the links don't work. The Wikipedia page on Lorentz Transformations contains material that is very relevant to this module. Very recommended. The following lecture notes or Links are at different levels. they basically cover more than the elementary half of this module. THE MP352 should make you comfortable 4-vector and index notations. This is covered in many of the textbooks or notes related above. The following links can also help. In MP352, we discuss Lorenz's group (along with the rotation group and the Poincare group); they are not covered by more elementary procedures or in Nash notes. The following links can help. Electromagnetism in the special theory of relativity is covered by some of the above references. Also: Widely discussed basic material that is mathematically simple but causes conceptual confusion: Decisions of previous exams - Examples of exams below are solutions for some past exams. (The length of exams has changed since 2017.) 2018 August (repeat) exam 2018 May exam 2017 May exam 2016 August (repeat) Exam 2016 May exam 2015 May exam Below are samples of exams for practice. They are in the style of previous (2017-2018) exams. Future exams may be structured slightly differently, but the material covered and the level of difficulty should be similar. Sample exam 1 Exam sample 2 Exam sample 3 Exam sample 4 4