Krane modern physics pdf

Text Mecano INSTRUCTOR SOLUTIONS MANUAL Instructor-u2019s Manual to accompany Modern Physics, 3rd Edition Kenneth S. Krane Department of Physics Oregon State University ©2012 John Wiley & Sons ii Preface This Instructor-u2019s Manual accompanies the 3rd edition of the textbook Modern Physics (John Wiley & Sons, 2012). Includes (1) explanatory material for each chapter; (2) suggested external readings for instructor or student; 3) references to websites or other generally available simulations of phenomena; (4) exercises that can be used in various strategies of active participation in the classroom; (5) sample exam questions; and (6) complete solutions to end-of-chapter problems in the text. Perhaps the greatest influence on my teaching over time since the publication of the 2nd edition of this textbook (1996) has been the growth in the maturity of the field of physical education research (PER). Instead of indicating specific areas of misunderstanding, PER has shown that student understanding is reinforced by any of a number of interactive techniques that are designed to engage students and make participants active in the learning process. Proven learning improvements are robust and replicable, and transcend the differences between instructors and institutional types. In my own career in this process, I have been especially influenced by the work of Lillian McDermott and her group at the University of Washington1 and Eric Mazur at Harvard University.2 I am grateful to you not only for your contributions to PER, but also for your friendship over the years. Supported by a National Science Foundation3 Course, Curriculum and Laboratory Improvement Scholarship3, I have developed and tested a set of exercises that can be used in class as group or out-of-class activities (for example, in a Peer Instruction mode in the Mazur-u2019s format or in a Just-In-Time Teaching4 mode). These exercises are included in this Instructor-u2019s Manual. I am grateful for the support of the National Science Foundation to enable the realization of this project. Two graduate students from Oregon State University assisted in the implementations of these reformed teaching methods: K.C. Walsh helped produce several simulations and illustrative materials, with the implementation of an interactive website, and with corresponding developments in the laboratory accompanying our course, and Pornrat Wattanakasiwich undertook a PER5 project for his PhD that involved observing student reasoning about the probability , which is at the heart of most themes of modern physics. One of the main topics that has emerged from PER over the past two decades is that students can often learn successful algorithms to problems while lacking a fundamental understanding of the underlying concepts. The importance of classroom or preclass exercises is to force students to consider these concepts and apply them to a variety of that often cannot be analyzed with an equation. It is absolutely essential to devote class time to these exercises and move forward with exam questions that require similar analysis and a similar articulation of conceptual reasoning. I firmly believe that conceptual understanding is a prerequisite needed to solve problems successfully. In my own classes at Oregon State University I have repeatedly observed that better conceptual understanding leads directly to better problem-solving skills. In training students to reason conceptually, it is necessary to force them to verbalize their reasons for selecting a particular answer to a conceptual or qualitative question, and they will learn a lot by listening to or reading their arguments. A simple highlight highlight highlight iii multiple-choice conceptual question, either as a class exercise or a test problem, gives you insufficient insight into students' reasoning patterns-u2019 unless you also ask them to justify their choice. Even when I have teaching assistants who grade the exams in my class, I always grade the conceptual questions myself, if only to gather information about how students reason. To save time, generally rate those questions with full credit (correct choice of answer and reasoning more or less correct) or without credit (incorrect choice or correct choice with incorrect reasoning). An example of why students need to be required to provide conceptual arguments. After a unit in the Schr-dinger equation, say the following conceptual test question: Consider a particle in the first excited state of a one-dimensional infinite potential energy well that extends from x to 0 to x to L. Where is the particle most likely to be located? Students had to give an answer and give their reasoning. A student drew a good sketch of the probability density in the first excited state, correctly showing maximums in x to L/4 and x to 3L/4, and declared that those locations were the most likely to find the particle. If I had not required reasoning, the student would have received full credit, and I would have been satisfied with the student's understanding-u2019s of the material. However, in asserting reasoning, the student demonstrated what turned out to be a surprisingly common wrong mode of reasoning. The student apparently mistook the probability density chart for a similar type of potential rollercoaster energy diagram from introductory and reasoned physics as follows: The particle moves more slowly at the peaks of the distribution, so it spends more time in those places and is therefore more likely to be there. For follow-up work, he indicated that confusion was caused in part by the combination of probability distributions with energy level diagrams. As a result, I adopted a class policy (and in this edition of the textbook) of showing wave functions or probability distributions on the same graph as energy levels. The overwhelming majority of PER's work has been concerned about the introductory course, but the effective pedagogical techniques revealed by that research are transferred directly to the modern physics course. The research collection directly related to the subjects of modern physics is much smaller, but no less revealing. The University of Washington group has produced several documents affecting modern physics, including understanding particle interference and diffraction, time and concurrency in special relativity, and photoelectric effect (see documents listed on its website, ref. 1). Edward F. Redish's PER group at the University of Maryland has also participated in the study of learning quantum concepts, including the 2019 student prejudices of classical physics, probability and conductivity.6 (More work on learning quantum concepts has been carried out by the research groups of two of Redish-u2019 PhD students , Lei Bao at Ohio State University7 and Michael Wittmann at Maine University.8) Dean Zomanll-u2019s group has developed tutorials and visualizations to improve teaching quantum concepts at many levels (from undergraduate to advanced undergraduate).9 The University of Colorado physical education group, led by Noah Finkelstein and Carl Wieman, is actively looking for several areas of research involving modern physics and has produced numerous research papers , as well as simulations on topics of modern physics.10 Others who have conducted research on teaching quantum mechanics and have developed Kenneth S. Emeritus) at Oregon State University, where he has served on the faculty since 1974, including 14 years as Head of Department. He received a doctorate in nuclear physics from Purdue University in 1970 and held postdoctoral research positions at los Alamos National Laboratory and Lawrence Berkeley National Laboratory before joining the Oregon State Faculty. His research involves nuclear structure and nuclear spectroscopy, and has led to more than 100 articles in reference journals and 30 years of funding in experimental nuclear physics from NSF and DOE. He was selected to be a member of the American Physics Society by the Division of Nuclear Physics. He also participates in educational research and curriculum development and has held numerous NSF fellowships supporting these activities. He has been chairman of the ApS Education Committee, the APS Forum on Education and the AIP Physical Education Advisory Committee. From 1995 to 2006 he was director of the New Faculty of Physics and Astronomy Workshop, a national tutoring program for college and university students. In 2004 he was awarded the Millikan Medal of the American Association of Professors of Physics in recognition of his contributions to teaching physics. Teaching. Teaching.