

INTRODUCTION

Solving problems in school work is exercise of mental faculties, and examination problems are usually picked out from problems in school work. Working out problems is thus an essential and important aspect of the study of Physics.

Major American University Ph.D. Qualifying Questions and Solutions is a series of seven volumes. The subjects of each volume and the respective referees (in parentheses) are as follows:

1. Mechanics (Qing Yuan-qi, Gu En-pu, Cheng Jia-fu, Li Ze-hua, Yang De-tian)
2. Electromagnetism (Zhoo Shu-ping, You Jun-han, Zhu Jun-jie)
3. Optics (Bai Gui-ru, Guo Guang-can)
4. Atomic, Nuclear and Particle Physics (Tin Huai-cheng, Yang Bao-zhong, Fan Yang-mei)
5. Thermodynamics and Statistical Physics (Zheng Jiu-ren)
6. Quantum Mechanics (Zhang Yong-de, Zhu Dong-pei, Fan Hong-yi)
7. Solid State Physics, Relativity and Miscellaneous Topics (Zhang Jia-lu, Zhou You-yuan, Zhang Shi-ling)

This series covers almost all topics of University Physics and contains 2550 problems, most of which are solved in detail.

The problems have been carefully chosen from a collection of 3100 problems, of which some came from the China-U.S.A. Physics Examination and Application Program, some were selected from the Ph.D. Qualifying Examination on Experimental High Energy Physics sponsored by Chao Chong Ting, and the rest came from the graduate preliminary or qualifying examinations of the following seven world-renowned American universities: Columbia University, University of California at Berkeley, Massachusetts Institute of Technology, University of Wisconsin, University of Chicago, Princeton University, State University of New York at Buffalo.

Generally speaking, examination problems of physics in American universities do not involve too much mathematics. Rather, they are to a

large extent characterized by the following three aspects. Some problems involving various frontier subjects and overlapping domains of science had been selected by professors directly from their own research work and have an “up-to-date flavor”; some problems involve broad fields and require a quick mind to analyze, while the methods needed for solving the other problems are simple and practical but require a full “touch of physics”. Indeed, we venture to opine that the problems, as a whole, embody to some extent the characteristics of American science and culture, as well as the philosophy underlying American education.

Therefore, we consider it worthwhile to collect and solve these problems and introduce them to students and teachers in general, even though the effort involved was formidable. As many as a hundred teachers and graduate students took part in this time-consuming task.

A total of 165 problems make up this volume of three parts: solid state physics (81), relativity (28) and miscellaneous topics (56). In scope and depth, most of the problems conform to the undergraduate physics syllabi for solid state physics and relativity in most universities. The miscellaneous part tests the student’s comprehension of general principles, familiarity with magnitudes and scales, knowledge of the history of physics, ability to estimate experimental errors, as well as his/her mathematical skills. Some questions are on the latest development in physics, purporting, no doubt, to test the scope of the student’s scope of general reading. Yet a few others relate to the student’s university and its research; these are not solved but are included for reference only.

The problems in this volume were solved by: Guo Zhi-chun, Chen Bing, Wang Ping, Zhang Shi-ling, Zhu Bing, Wang Yong, Zhou Dong-fang, Ning Bo, Wang Shan-xia, Si Qi-miao, Lu Jian-xin, Qiu Xiu, Wang An-min, Sun Yi, Jing Yi-peng, Liu Yu-zhen, Liu Fang-xin and Zhung Zhen-quan, and the initial translation from Chinese to English was carried out by Zhang Shu-zhen, refereed by Zhu Xing-fen and Ding Ze-jun.