

## Solutions to Problems in Solid State Physics II

### Problem 2005-I

$\varepsilon_A$  is the maximum energy of band 1 (follows from the specification of the Fermi surface). The number of electronic states in one band, within the 1. Brillouin zone, is twice the number of  $k$  states, i.e. twice the number of unit cells in the system. If  $\varepsilon_h < \varepsilon_c$  all states in band 1, and no states in band 2, would be occupied by electrons at zero temperature, implying that

1) the system would be an insulator (or semiconductor).

The reciprocal lattice of an fcc is a bcc lattice. In the bcc reciprocal lattice there are 8 equivalent (111) reciprocal lattice points lying at the corners of the 1. Brillouin zone, each counting one-eighth. This implies that there is, effectively, one hole and one electron Fermi surface in one Brillouin zone. With the use of the notation introduced on the figure, we have:

$$\varepsilon_F = \varepsilon_c + \frac{(\hbar k_c)^2}{2m_c} = \varepsilon_h - \Delta + \frac{(\hbar k_h)^2}{2m_h}, \quad \varepsilon_F = \varepsilon_h - \frac{(\hbar k_h)^2}{2m_h}. \quad (1)$$

The number of holes (i.e. the number of missing electrons) in band 1 is equal to the number of electrons occupying band 2, i.e.

$$n = p. \quad (2)$$

and since both bands are parabolic, we may use Marder eq. (6.29) to obtain the lengths of the two Fermi wave vectors:

$$k_c = (3\pi^2 n)^{1/3}, \quad \text{and equivalently} \quad k_h = (3\pi^2 p)^{1/3}. \quad (3)$$

These equations are straightforwardly solved, and we get

$$2) \quad \varepsilon_F = \varepsilon_A - \frac{m_c}{m_c + m_h} \Delta.$$

$$3) \quad n = p = \frac{1}{3\pi^2} \left( \frac{2\Delta}{\hbar^2} \frac{m_c m_h}{m_c + m_h} \right)^{3/2}.$$

According to Marder eqs. (6.77) and (6.23), the specific heat is

$$c_V = \frac{\pi^2}{3} k_B^2 T D(\varepsilon_F), \quad D(\varepsilon_F) = \frac{m}{\hbar^3 \pi^2} \sqrt{2m\varepsilon_F} = \frac{mk_F}{\hbar^2 \pi^2}, \quad (4)$$

in the case of a parabolic band, when  $T \ll \varepsilon_F/k_B$ . In the present case, we need to require  $T \ll \Delta/k_B$ , and adding the electron- and hole-like contributions,

$$D(\varepsilon_F) = \frac{m_c k_c}{\hbar^2 \pi^2} + \frac{m_h k_h}{\hbar^2 \pi^2} = \frac{m_c + m_h}{\hbar^2 \pi^2} \left( \frac{2\Delta}{\hbar^2} \frac{m_c m_h}{m_c + m_h} \right)^{1/2} \quad (5)$$

the result is

$$4) \quad \gamma = c_V/T = \frac{k_B^2}{3\hbar^2} \sqrt{2m_c m_h (m_c + m_h) \Delta}.$$

# Problems In Solid State Physics With Solutions

**Yung-kuo Lim**



## **Problems In Solid State Physics With Solutions:**

Problems In Solid State Physics With Solutions Fuxiang Han,2011-10-31 This book provides a practical approach to consolidate one's acquired knowledge or to learn new concepts in solid state physics through solving problems. It contains 300 problems on various subjects of solid state physics. The problems in this book can be used as homework assignments in an introductory or advanced course on solid state physics for undergraduate or graduate students. It can also serve as a desirable reference book to solve typical problems and grasp mathematical techniques in solid state physics. In practice it is more fascinating and rewarding to learn a new idea or technique through solving challenging problems rather than through reading only. In this aspect this book is not a plain collection of problems but it presents a large number of problem solving ideas and procedures some of which are valuable to practitioners in condensed matter physics. *Solid State Physics* László Mihály, Michael C Martin,2009-02-24 The ideal companion in condensed matter physics now in new and revised edition Solving homework problems is the single most effective way for students to familiarize themselves with the language and details of solid state physics. Testing problem solving ability is the best means at the professor's disposal for measuring student progress at critical points in the learning process. This book enables any instructor to supplement end of chapter textbook assignments with a large number of challenging and engaging practice problems and discover a host of new ideas for creating exam questions. Designed to be used in tandem with any of the excellent textbooks on this subject *Solid State Physics Problems and Solutions* provides a self study approach through which advanced undergraduate and first year graduate students can develop and test their skills while acclimating themselves to the demands of the discipline. Each problem has been chosen for its ability to illustrate key concepts, properties and systems knowledge of which is crucial in developing a complete understanding of the subject including Crystals, diffraction and reciprocal lattices, Phonon dispersion and electronic band structure, Density of states, Transport, magnetic and optical properties, Interacting electron systems, Magnetism, Nanoscale Physics. **Problems in Solid State Physics with Solutions** Fuxiang Han,2011 *Understanding Solid State Physics* Jacques Cazaux,2016-03-23 The correlation between the microscopic composition of solids and their macroscopic electrical, optical, thermal properties is the goal of solid state physics. This book is the deeply revised version of the French book *Initiation à la physique du solide exercices commentés avec rappels de cours* written more than 20 years ago. It has five sections. Problems and Solutions in Solid State Physics S. O. Pillai,1994-01-01 Modern Physics And Solid State Physics (problems And Solutions) S O Pillai,2006 The Purpose Of This Book Is To Motivate The Students To Organize Their Thoughts And Prepare Them For Problem Solving In The Vital Areas Of Modern Physics And Physics Of Condensed Materials. Each Chapter Begins With A Quick Review Of The Basic Concepts Of The Topics And Also A Brief Discussion Of The Equation And Formulae That Are To Be Used For Solving The Problems. Examples And Illustrations Are Provided Then And There To Expedite The Learning Process And The Working Knowledge About Six Hundred Problems Have Been Treated

In Total Two Hundred Problems Have Been Worked Out Providing All Minute Details Answers For The Other Four Hundred Problems Have Been Provided At The End Of The Book This Book Will Cater The Needs Of Undergraduate And Postgraduate Students Of Physics Chemistry Materials Science And All Branches Of Engineering Except Civil Engineering Candidates Appearing For The Gate And Other Competitive Examinations Would Find This Book Useful

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*Problems And Solutions On Solid State Physics, Relativity And*

*Miscellaneous Topics (Second Edition)* Swee Cheng Lim, Choy Heng Lai, Leong-chuan Kwek, 2024-03-14 This volume is a comprehensive compilation of carefully selected questions at the PhD qualifying exam level including many actual questions from Columbia University University of Chicago MIT State University of New York at Buffalo Princeton University University of Wisconsin and the University of California at Berkeley over a twenty year period Featuring a division into the three parts which form the title topics covered in this book include the crystal structure superconductivity general relativity special relativity and measurements among many others This latest edition has been updated New problems and solutions have been added while the original problems are modernized excluding outdated questions and emphasizing those that rely on calculations The problems range from fundamental to advanced in a wide range of topics easily enhancing the student's knowledge through workable exercises Simple to solve problems play a useful role as a first check of the student's level of knowledge whereas difficult problems will challenge the student's capacity on finding solutions **SOLID STATE PHYSICS**

S. D. Aghav, B. M. Laware, P. S. Tambade, 2019-08 The problems are judiciously selected and are given topic and section wise The approach is straight forward and step by step solutions are elaborately provided More importantly the relevant formulas used for solving the problems can be located in the beginning of each chapter There are number of diagrams for illustration

Problems In Solid State Physics D. K. Dhawan, 2003 **Solid State Physics** Mircea S. Rogalski, Stuart B.

Palmer, 2000-05-30 Solid State Physics opens with the adiabatic approximation to the many body problem of a system of ions and valence electrons After chapters on lattice symmetry structure and dynamics it then proceeds with four chapters devoted to the single electron theory of the solid state Semiconductors and dielectrics are covered in depth and chapters on magnetism and superconductivity follow The book concludes with a chapter on solid surfaces Every section is followed by solved problems some of them illustrating areas of current interest in solid state physics to give the student a practical working knowledge of the subject and the text is illustrated by many supplementary examples *Solved Problems in Solid State Physics* R. Asokamani, 2026-08-03

*Solved Problems in Solid State Physics* contains more than five hundred solved problems and covers the latest developments in the area of solid state physics including recent findings on topics including high temperature superconductivity and nanomaterials The book fuses pedagogical introductions and sections of worked problems to guide students on their physics education journey Dr Asokamani has published textbooks on solid physics which incorporate much content on fundamentals and theory and this book is an expansion on these topics concentrating fully on worked problems This will enable students research scholars and faculty members to gain a better understanding on the principles involved in various topics and their varied applications The numerical values provided at the end of the problems will grant them insight into practical applications of real engineering applications *Solved Problems in Solid State Physics* contains solved problems with the multiple choice questions numbering around eight hundred This book is a culmination of years of teaching and research for more than four decades Over one hundred books and journals have been referred to in the

preparation of this book and references and resources are clearly stated in each chapter Problems have been chosen in the areas of solid state physics material science and metallurgy and ancillary material provides detailed theory and lectures summarizing the problems

**Solid State Physics** J. R. Hook, H. E. Hall, 2013-07-17 This Second Edition is aimed at students taking a first course in this subject although it will also be of interest to professional physicists and electronic engineers requiring a grasp of the fundamentals of this important area of physics Basic concepts are introduced in an easily accessible context for example wave propagation in crystals is introduced using one and two dimensional geometries Only when these basic ideas are familiar are generalisations to three dimensions and the elegant framework of the reciprocal lattice made Extensively rewritten the Second Edition now includes new and expanded coverage of semiconductor devices the quantum Hall effect quasicrystals high temperature superconductors and techniques for the study of the surfaces of solids A chapter on dielectrics and ferroelectrics has also been added Solid State Physics Second Edition features A carefully written and structured text to help students fully understand this exciting subject A flow diagram allowing topics to be studied in different orders or omitted altogether Optional starred and highlighted sections containing more advanced and specialised material for the more ambitious reader Carefully selected problems at the end of each chapter designed to assist learning Solutions are provided at the end of the book

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web jul 22 2023 step 5 stop this process when you reach your desired length of chain now put another empty rubber band through the pencils make sure you don t twist it again pull the rubber band just below it to the top of the empty rubber band similar to the previous steps attach hook between the empty rubber bands at both ends and remove the pencils

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web step 1 this is the rainbow loom kit step 2 you will need rubber bands rainbow loom crochet hook and c clips in my hand step 3 make sure the arrows are pointing up on your rainbow loom this is the way it will stay while you lay the rubber bands on ask question step 4 now place the first color you chose on the pegs like so

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web step 1 materials you will need a rainbow loom kit rubber bands rainbow loom hook c clip or s clip step 2 making the bracelet take one rubber band and twist it around two pegs on you loom step 3 then once you have the twisted rubber band on the pegs add two more and do not twist them step 4 the hook

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web step 1 your material all you need to make these bracelets are 40 rubber bands 20 of each color an s or c hook and your fingers ask question step 2 the first band add a band to your index finger flip it over the put the other side on your middle finger ask question step 3 the next bands

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