

Report on B3.VI (Condensed-Matter Physics) 2011

Overall, it appears that candidates stuck to familiar material that was present in the previous syllabus and perhaps did not attempt questions that dealt with less familiar material present in the new syllabus. It is also worth considering that with only four questions available to choose from, the syllabus cannot be fully covered in the examination and this may put some candidates at a disadvantage.

Q.5 (154 attempts, mean 16.3, s.d. 5.1) This was the most popular question, with virtually all candidates (93%) attempting it. Although it was generally well done (it recorded the highest mean score), there were a few difficulties. While candidates were quite familiar with expressing X-ray diffraction using the Fermi Golden Rule, many appeared to be unfamiliar with simple Fourier transforms (first part), and a surprising number made errors in evaluating X-ray diffraction intensities after having set up the proper expression for the complex diffraction amplitude.

Q.6 (103 attempts, mean 14.8, s.d. 5.8) Another popular question (62%). The first part was done well, although marks were lost where the Taylor series expansion of the potential, including anharmonic terms, was omitted. The second part was also well done; the most common difficulty was not recognising that the force constant could be obtained from the second derivative of the potential. The atomic mass of argon was not given in the question, but most candidates estimated it from the atomic number; all reasonable estimates were accepted.

Q.7 (38 attempts, mean 14.7, s.d. 5.0) This question looked complicated which possibly discouraged some candidates from attempting it (23%). Nevertheless it was well done. Candidates were familiar with the use of degenerate perturbation theory to obtain energy gaps, but there was some misunderstanding that the energy gap at $(\pi/a, 0)$ involved both Fourier components V_{10} and V_{11} of the potential. Otherwise, obtaining the energy levels and recognising the condition for the transition between metallic and semiconducting behaviour arising from overlapping bands was quite straightforward.

Q.8 (33 attempts, mean 12.3, s.d. 5.2) This was the least popular question (20%) and had the lowest mean score. Many candidates could not sketch the Brillouin function, a significant number made errors in expanding it in the limit $x \ll 1$ in order to obtain the magnetisation. A number of candidates made the treatment of ferromagnetic behaviour over complicated by attempting a full statistical mechanical treatment, but on the other hand there were also some very nice solutions presented for exchange energy.