Report on C3 2007

44 candidates took the paper, the mean was 64.98 and the SD 14.17 range 35-89.

The C3 paper was generally well answered with candidates exhibiting a good understanding of all parts of the course. In general the quality of answers was a little higher than in the previous few years.

1. 25 attempts Mean 16.1 SD 5.3 range 2-24

   This question required the candidate to work with experimental absorption data from both bulk GaAs and a GaAs quantum well. This was a reasonably popular question and in general candidates showed a good depth of knowledge of the subject area covered. In a number of cases the candidates did not specifically address the questions asked. In particular there was some reluctance to discuss the features of the data shown in the figure. Some candidates also lost marks by stating results instead of deriving them as asked in the question.

2. 13 attempts Mean 14.2 SD 5.9 range 4-23

   This question concerned treating the bandstructure of graphene in terms of the nearly free electron model. The question required candidates to have a firm understanding of bandstructure as it involved both calculations and interpretation of calculated results. Clearly a number of those who attempted this question did so as their last question and ran out of time having completed only the first few parts. There were a number of excellent answers to this question.

3. 9 attempts Mean 15 SD 6.1 range 7-25

   Most candidates made a good attempt at the derivation of Bloch's theorem, which was standard bookwork, and most could describe its significance. Candidates were widely separated by their responses to the second half of the question on Bloch oscillations. Some candidates became confused about the origin of Bloch oscillations.

4. 36 attempts Mean 17.5 SD 5.4 range 6-25

   Most candidates attempted this question on the Landau theory of ferromagnetism. Nearly all candidates scored full marks on the straightforward minimisation problem in part (a). However many had difficulties obtaining expressions for the magnetic susceptibilities in part (b) - this was mostly a result of candidates not making the correct approximation for the magnetisation in the $T < T_c$ and $T > T_c$ cases. In the final part of the question some candidates were let down by their basic thermodynamics, but in general this part of the question was also answered well. There was a typographical error in the last equation of this part: $a_0^2(T_C - T)^2/2b$ should have read $a_0^2(T_C - T)^2/4b$. Many candidates pointed out the error in their scripts while others did not notice it. In both cases candidates were awarded the full two marks that were allocated to this part of the question. The error appeared to have very little effect on the performance of candidates.

5. 16 attempts Mean 15.8 SD 6.3 range 5-25

This magnetism question had four distinct sections. Many candidates missed the difference between the saturation magnetisation and the effective magnetic moment. Surprisingly, the answers to the last part on domains were also mixed, with candidates either getting full marks or suggesting that the magnetisation of soft iron was zero because T was greater than T_c

6. 18 attempts Mean 13.5 SD 5.4 range 4-20

   Whilst many candidates gave good explanations for the difference between symmorphic and non-symmorphic space groups, there was general ignorance of what a primitive lattice was! This question dealt with the $Pmmm$ space group, and the answers were often poor. Many candidates failed to construct the stereographic projection and most missed the fact that there was a centre of inversion. Few managed to obtain the correct structure for $KAuO_2$.

7. 23 attempts Mean 16.7 SD 4.7 range 6-22

   Candidates attempting this question had a good grasp of reciprocal lattices. The answers were of a high standard, although many could do the structure factor calculation, fewer could construct the $hk0$ section of the reciprocal lattice as a sketch before undertaking the full calculation. The last part proved the most challenging to weaker candidates.

8. 36 attempts Mean 17.3 SD 3.7 range 9-24

   This was one of the two most popular questions on the paper. Candidates handled the Meissner Effect well, and could almost all derive the thermodynamics of the critical induction. Some confusion over the relevance of the Meissner Effect was evident, and the reasons for limited currents in the vortex state proved difficult for many. Nonetheless the answers were generally good and the concepts seem well understood.