Paper B1 2006

The B1 paper had 147 Physics candidates + 7 Physics and Philosophy candidates. It was normalised from a mean of 68.0 to 65.0. The majority answered questions 1,2,4,5,6. This worked well, since questions 5 and 6 were actually difficult, students sometimes looked at the possibilities within questions 3,7,8. The aim was to have the questions short enough that there was time to think and that the exam was not simply a race against time; this was partially succesful, although about 30the end. The section A questions were perhaps a bit too straightforwrd all the way through to the end.

Question 1: Attempts: 112 Mean: 15.0 Sigma: 3.77

Good answers generally. Most people knew the quantum defect formula and that it was reasonable to make it a function of l alone. A large fraction of the answers to the first part explained why the chemical features differed across the periodic table and not how the Pauli Exclusion Principle govered the shape of the table and the different possible values of m_l and m_s. A few unfortunates misidentified the ground state of sodium and drew transitions to the 1s level.

Question 2: Attempts: 139 Mean: 15.2 Sigma: 3.43

A well answered and popular question. Quite a few did not explain the central field approximation at the start. The last part usually yielded a statement of the rules and no a descripion of the physics behind it.

Question 3: Attempts: 35 Mean: 11.8 Sigma: 4.09

Unpopular question. The first part was answered well. The mathemaical bit in the middle requires starting from a differential equation (which is straightforward to solve); just using exponential decay laws is insufficient. The last part was found to be difficult [from the result of the previous part, assume the decay rate of all species in the radioactive chain is governed by the rate of the first long-lived one; so number of radon atoms = number of Pb(210) found in the rainwater.]

Question 4: Attempts: 112 Mean: 15.5 Sigma: 3.36

Generally well answered question. The explanation for double-β decay was universally good, although a few said it is applicable to even-A rather that even-even. Sometimes there was a reluctance to use the expression obtained for E^5 on the data in the table. The table was erroneously introduced as 'β^+-decays' rather than 'β-decays' in the version of the paper used during the exam.

Question 5: Attempts: 119 Mean: 12.0 Sigma: 4.23

Many students didn't comment that the massless photon causes the EM force to be long range. Part (b) was also difficult. Many students had learned that the propagator is $1/(M^2 + q^2)$ whereas for an s channel it is $1/(M^2 - q^2)$ to give the resonance at the Z pole. The last bit was done rather well.

Question 6: Attempts: 120 Mean: 10.6 Sigma: 3.32

The relativity part was difficult. Candidates often didn't find the condition to give the maximum muon momemtum and many did not consider the COM frame. Ony two candidates got it exactly right [Construct a particle X which decays to the K(892) and neutrino; X goes backwards and muon goes forwards in COM frame]. The last part of the question was pleasingly rich in discussion possibilities and answers were varied, Some were very good.

Question 7: Attempts: 18 Mean: 12.6 Sigma: 4.47

Very unpopular question which was found easy by those who did not run out of time.

Question 8: Attempts: 54 Mean: 13.9 Sigma: 5.13

Impressive answers quite a lot of the time. A small fraction of the candidates didn't start by using the Lorentz transformation and spent some time trying to use invariants instead.