Examiner's Feedback report on examination PH559 – Advanced Topics in Nuclear Physics

12 students sat this exam. The average mark obtained was 67.9%. The highest mark was 90% and the lowest was 51%

Section A

Q1. This was a compulsory question and was attempted by all students. The average mark was 27.4/40. Most students got part (a) correct, except that a few missed out key details on the nuclear force and parity. Parts (b) and (c) were answered correctly by most. Some students mixed up the Q-value equations and didn't know why positron emission is less common. Part (d) was answered well, but most failed to indicate that the emitted gamma ray cannot have zero angular momentum. (e) Most students got the general form of the plots correct, although some drew the wrong shape and others did not label the time axis. (f) Most students correctly identified the terms and how they change. (g) Only a few students were able to correctly identify the differences between the various accelerators. (h) Most students listed appropriate reactions.

Section B

Q2. All 12 students chose this question and the average mark was 11.3/15. The question was generally answered well by all. Some missed key details in the explanations for (a) – (d). (e) Most students calculated the binding energies correctly, but not all were able to comment on why the decay is favourable. (f) Most students calculated Z_min correctly, but not all correctly identified the most stable nucleus.

Q3. 10 from 12 students chose this question and the average mark was 9.1/15. The question was generally answered well, except that the key details were missing from answers for part (a) on the gamma ray properties. Most students failed to calculate the excitation energy correctly in part (b).

Q4. 2 from 12 students chose this question and the average mark was 10.5/15. (a) was answered well. (b) This part of the question was also answered well. (c) The students made a good attempt at this part of the question, but failed to calculate lamda-bar correctly. The partial width was correctly calculated.

Section C

Q5. 11 from 12 students chose this question and the average mark was 10.0/15. Most students gave a good explanation of the indirect drive approach to ICF (although one student confused this with the fast ignition approach). Not all correctly identified the advantages and disadvantages. (b) Most calculated the kinetic energies of the particles correctly, but not everyone correctly calculated the Coulomb barrier energy. Most students correctly calculated the confinement time and identified the confinement technique, though not everyone justified their choice.

Q6. 8 from 12 students chose this question and the average mark was 10.3/15. (a) Most students were able to correctly sketch the form of the potential energy, though not all labelled it correctly. (b) Most correctly worked out the missing particles and the Q-values. Not all students correctly calculated the distance separating the centres of the fission fragments. Some used the wrong values of the radii. Most had the correct approach. Few students were able to clearly identify the main differences in the fissablility of the two uranium isotopes.

Q7. 5 from 12 students chose this question and the average mark was 9.4/15. (a) Some students did not correctly calculate the energy released in the positron decay. This should have been calculated as the Q-value. Some had difficulty calculating the activity of the sample, although most had the correct general approach. (b) All students correctly calculated the magnetic field strength, but some incorrectly calculated the difference in energies of the two proton states. (c) Most students gave a good description of the optimum procedures for radiation dose therapy and the advantages of using protons.