Examiner reports

Q1.

This question was generally not well answered, although few were left blank. Students tended to mix up beta-minus, beta-plus, neutrino and anti-neutrino.

In (a), only around half identified the beta-plus decay; in part (b) fewer than half deduced the electron neutrino. More students did successfully identify the anti-particle, although a significant proportion did not attempt this part.

Q2.

There was a wide variety in the quality of responses for this question. There were some very well-written responses, and around 15% scored full marks or four out of the maximum five. However, the majority of students scored less than three marks. The common marking points that were awarded were the idea of a background count, and 'repeats and averages'. Few students correctly described the straight-line graph, with most students suggesting plotting C versus r (which would yield a curve). This cohort, as previous cohorts, was found generally to be less confident with describing practical procedures. A significant proportion did not attempt this question at all.

Q3.

Students scored poorly in this question.

Q4.

Students scored highly in this question.

Q6.

This question was well attempted by most students. For the calculations in (a), over half scored at least one mark, while some students confused antiprotons and electrons, and others did not specify the sign for the charge. In part (b), a description of the process of annihilation, was well attempted, with 40% of students scoring at least three marks out of four.

Q7.

In part (a), the majority of students identified some sort of neutrino; for two marks, the neutrino needed to be specified as an electron-neutrino.

Most students scored the first mark in (b), a non-standard half-life question, by indicating that the fluorine nuclei had quartered in number. However, only about a fifth of students calculated the new ratio of nuclei numbers correctly.

Part (c) was very poorly answered. At this level, a vague comment about the half-life being short is insufficient; as a question in a practical context, some reference to directly-measurable quantities is required. In this case, a comparison between the diminished count rate and the background count rate was required.

Q8.

Students were less successful in questions requiring manipulation of quantities in algebra, with no numbers given like this one.

Q9.

Most students identified that the particle involved was a β^- particle and went on to calculate the proton and nucleon numbers correctly. A few misidentified the nature of the decay, while others wrote an incorrect symbol for the beta decay. It should be noted that students are expected to know appropriate symbols and the substitution of a b or B instead of β was not considered to be worthy of a mark.

Q10.

Many students made no attempt at either part (a), part (b) or both parts of this question. Few students understood the concept of rest energy. A few more managed to convert MeV into joules correctly. Missing the significance of the M in MeV was a common error.

Q14.

This question was found to be particularly difficult.

Q15.

Students' overall performance in the multiple choice questions tended to be slightly better than their performance in the rest of the paper but the difference was only small.

Q16.

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Q17.

All candidates got this question at least partly correct with many getting full marks. Most knew the products of decay and made a good attempt at getting all of the details of the proton and nucleon numbers correct. Candidates were expected to stipulate that it was an antineutrino that was produced. However, on another occasion, it may be expected that they further identify the particle as an electron antineutrino.

Q18.

As a whole this question was well done but weaker candidates had a tendency to omit relevant detail. In (a) candidates were expected to comment on the mass and the charge of a positron. It was considered that a statement that the charge was positive was insufficient. In (b) candidates tended to know about annihilation but some did not realise or think it worth stating that two gamma ray photons were produced in the process. When candidates made an attempt at (c) they were usually successful but a surprising number seemed unable to deal with the idea of half-lives.

Q19.

It was noticeable that the more successful candidates made more annotations to their scripts in the multiple choice section – doing some calculations or formalising their thought processes. Conversely, weaker candidates often simply selected one of the available answers.

Q20.

This question was answered successfully by the great majority of candidates. It was noticeable that the more successful candidates made more annotations to their scripts in the multiple choice section – doing some calculations or formalising their thought

processes. Conversely, weaker candidates often simply selected one of the available answers.