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Physics A PHYA1

(Specification 2450)

Unit 1: Particles, quantum phenomena and electricity

Report on the Examination

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GCE Physics, Specification A, PHYA1, Particles, quantum phenomena and electricity

General Comments

The paper proved to be quite accessible and the majority of candidates approached a high proportion of the questions in a confident manner. There was compelling evidence of careful preparation across the whole specification content. The topics that seem to cause the candidates the most problems were the questions that required analysis of electric circuits. In particular questions that required candidates to make predictions about circuits without using calculations proved particularly challenging. Candidates found questions on quantum effects more accessible than has been the case in previous sessions and were able to demonstrate their knowledge of particles effectively.

In particular, the question requiring knowledge of particle classification generated some very good responses. Presentation was good and fewer answers went over the allotted spaces for questions than has been the case in the past. The dedicated marks for significant figures did not present candidates with too many problems, but in contrast to this, the mark for the unit for momentum did cause problems for a significant proportion of candidates. Some candidates did not write their answers using black ink as instructed and this did have an impact on the clarity of the scan of their answer.

Question 1

This question was answered well and candidates' demonstrated a clear understanding of the distinction between baryons and leptons. The most common examples of these particles given were protons and electrons although a significant minority successfully opted for more exotic particles. When stating the difference between hadrons and leptons some candidates responded saying that hadrons experienced the strong nuclear force but then spoilt their answer by not contrasting this with leptons or by saying leptons experience the weak interaction. Although the latter statement is true, it is not a property exclusive to leptons.

The Feynman diagram in part (b) was well understood. Many candidates provided a stated conservation law using clear before and after statements. This made it a straightforward task to follow their logic.

Question 2

This question proved accessible to candidates of all abilities and consequently was not particularly discriminating. Some candidates did struggle to identify the particle with the highest specific charge, with a significant minority opting for the proton. The equation for β was answered well, although it was not uncommon to see an equation representing changes in quark flavours rather than showing what happened to the nucleus as a whole. The antineutrino was the most common omission in the equations given.

Part (b) was answered well with the majority of candidates opting for a mass number between 220 and 230.

Question 3

This question on pair production suggested that while candidates are for most part, familiar with the process they do have the tendency to become confused when more details are required. The majority correctly identified the process and were able to use lepton or charge conservation effectively to explain why a positron must be produced along with the electron. They did however, find the quantitative aspect more of a challenge and it was not uncommon to see overcomplicated answers or no attempt made to answer part (iii).

The calculation for maximum wavelength in part (iv) was answered well by the more able candidates but others found this difficult. Common errors were not converting rest mass energy to joules and the use of energy as momentum when the equation for the de Broglie wavelength was used in error. Good answers to part (v) were frequently seen, although some candidates are under the impression that the positron annihilates with the electron produced rather than another electron.

Question 4

Descriptive questions on the photoelectric effect have in the past caused candidates major problems, it was therefore good to see so many confident answers this series. There was strong evidence that the concept of threshold frequency is now understood much better. Many candidates correctly explained the term and also were able to give a detailed explanation of its significance in the particle model of light. The one to one interaction and lack of time delay in the emission of electrons was also explained well in a high proportion of answers. Some good responses were not fully developed however, as they did not contrast the behaviour of photons with the behaviour of waves. This question also assessed the quality of written communication and most answers were well structured and expressed with clarity and precision.

The calculations in part (b) were answered well, although some less able candidates were unable to correctly use the equation for kinetic energy. There was a dedicated mark for the unit of momentum in part (ii) and, as is often the case, candidates found this a difficult unit to recall.

Question 5

Part (a) of this question on the meaning of root mean square voltage was not answered well, with the majority responding by quoting a formula rather than by referring to an equivalent direct voltage. In contrast part (b) was answered extremely well, with full marks being a common outcome.

In part (c), candidates were required to draw a graph of an alternating voltage and although some made a commendable attempt at this, there were a significant proportion of careless answers with waves of varying amplitude and time period being a common occurrence. There was also a tendency not to label the axes with appropriate values in spite of candidates being instructed to do this in the rubric.

Question 6

The majority of candidates were able to provide correct answers to parts (a) and (b) although a minority did use the maximum current of 0.40 A rather than the normal working current of 0.20 A.

Parts (c), (d) and (e) required more qualitative answers and proved to be much more challenging.

Part (c) was well answered, although some candidates were let down by a looseness in their technical language. An example of this occurred when a significant minority referred to the ‘filament increasing in heat’ rather than temperature.

Part (d) was not answered well and many candidates were confused by the context of the question and gave answers that generally related to series and parallel circuits. This meant that in (i) they stated the current was the same everywhere and therefore did not change, and in (ii) they stated that the current split and therefore decreased. In both these cases, they did not consider the effect the second bulb had on the resistance of the circuit.

Part (e) was more successfully answered by a significant proportion of the candidates, with many realising the significance of the rapid increase in temperature.

Question 7

This question proved to be very discriminating with only the more able candidates able to score high marks. The calculations involved in part (a) proved too challenging for many candidates. Part (a) (i) and (ii) generated the most correct responses, but the remainder of the analysis was only accessible to the more able candidates.

Part (b) required analysis without calculation and the majority of explanations seen were confused and not self consistent. Many candidates stated that more current goes through the thermistor and therefore the pd across it falls, resulting in the pd across the parallel 1200 Ω resistor increasing. Another common misunderstanding was the effect that the decreasing thermistor resistance had on the current through the battery. Many thought that the current remained constant and, although this still led them to deduce that the pd fell, their arguments frequently contained contradictions.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website.