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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 1451

Specification A

PHYA1 Particles, Quantum Phenomena and Electricity

Report on the Examination

2009 examination - January series

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GCE Physics, Specification A, PHYA1, Particles, Quantum Phenomena and Electricity

General Comments

The paper provided opportunities for all candidates to demonstrate and apply their knowledge and understanding of the topics in the unit. Many candidates provided evidence of careful preparation although some found the paper quite challenging. Statistics suggest that candidates were less confident with certain aspects of the electricity questions than they were with the questions on quantum phenomena. Questions 6 (b) and 7 were particularly discriminating and not many candidates scored full marks. To balance this, question 2 (b) and 3 generated many very strong answers. Presentation was good, although a number of answers went over the allotted spaces for questions. The dedicated marks for units and significant figures did not present candidates with too many problems although the unit for momentum was not well known. Candidates usually showed full working for calculations but this was often poorly set out, frequently resulting in incorrect answers due to unnecessary arithmetical errors.

Question 1

Correct responses for part (a) were common, although a significant minority of candidates did give the answer 12.75 eV which is the energy change from level one to level four.

The other parts of the question were answered well by the majority of candidates, with the only common errors occurring in the transition diagram, where often too many arrows were drawn or the arrows were shown in the wrong direction or there was no arrow at all. The calculation in part (b) (ii) was approached with confidence by many candidates and most appreciated that they were required to limit the number of significant figures in their answers.

Question 2

Part (a) was not answered well and there was much confusion as to the processes involved in the photoelectric effect. However, a significant number of candidates confused the effect with excitation and line spectra. Only a minority of candidates were able to explain why the kinetic energy of the emitted electrons varied. A common response referred to the photons having a variety of energies even though the question stated that the light had a certain frequency. Most answers lacked significant detail such as the idea that a photon interacts with one electron and how threshold frequency and work function are related.

This question assessed quality of written communication and it was clear that most candidates appreciated that their answers needed a logical structure. However, few candidates were able to give a coherent and comprehensive answer

Part (b) generated better answers although a significant minority of candidates did not appreciate the fact that the gradient of the maximum kinetic energy against frequency graph is the Planck constant.

Part (c) proved more difficult than expected and a number of candidates calculated the energy of the photon using the threshold frequency and failed to calculate the work function.

Question 3

This question was answered well, with a number of candidates obtaining high marks for it. A minority were confused by the interaction represented by the first Feynman diagram and stated that it was a weak interaction. The second interaction caused few problems and the majority of candidates were able to successfully complete it. There was strong evidence that conservation laws were understood although some candidates did not express themselves in a structured way making it hard to follow their deductions. The most successful wrote out the equation of the reaction and used this as a reference point.

Part (b) (iv) assessed how science works and candidates answered this question well.

Question 4

Part (a) was answered reasonably well and candidates generally understood the meaning of particle wave duality. Some candidates just referred to wave properties, presumably assuming that particle properties were self-evident.

In part (b) (i) it was noticeable that less able candidates confused momentum with energy. The unit for momentum also caused significant problems. The penalty for not being able to calculate momentum was not a major one, as consequential error was allowed for parts b (ii) and b (iii).

Question 5

For a number of candidates this question proved to be quite difficult. In part (a) there was much confusion about superconductivity with a significant proportions of candidates stating that the resistivity is very small or close to zero rather than making a clear statement that it is zero. The conditions necessary for superconductivity were also not clearly expressed and many candidates seemed to think that this was a high temperature property. The term critical temperature was seldom seen.

The calculation in part (b) (i) was done well but part (b) (ii) caused candidates more problems. Full marks were rare and although some candidates did appreciate that the copper still had resistance, they did not see this as effectively a question about parallel resistors.

Question 6

Part (a) was answered well, with many candidates obtaining full marks.

Part (b) caused more problems and the use of the power formula that involves potential difference and resistance was quite rare. In part (b) (ii) there was some confusion over potential difference and candidates frequently used their answer from part (b) (i). Part (b) (iii) was answered much better, with candidates frequently benefitting from consequential error.

Question 7

Most candidates were able to explain what is meant by internal resistance but were less clear about the meaning of the emf of a battery. Most appreciated that it was connected to energy but their answers were far from convincing.

Part (b) (i) produced some good responses although a number calculated the potential difference across the internal resistance as opposed to the terminal potential difference which meant that the answer 4.0 V was commonly seen.

Part (b) (ii) was generally answered well and the unit $J\,s^{-1}$ or W did not seem to present too many problems.

Part (c) is an application mentioned in the specification and there was good evidence that this is something that has been considered by most centres. The most common answer was that the current would be reduced. The effect of a reduced current was sometimes not clearly expressed and candidates tended to say things like it would take longer to start or that it would be more difficult to start rather than making a definite statement about the car not starting.

Mark Ranges and Award of Grades

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