Version 1.0: 0807

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 6451
Specification A

PHA8/W Turning Points in Physics

Report on the Examination
2007 examination - June series

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Set and published by the Assessment and Qualifications Alliance.

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General Comments

Most candidates were usually able to express their knowledge satisfactorily in their answers to the calculations and in some of the shorter descriptive questions. However, many candidates found difficulty in answering longer descriptive questions where several key points needed to be identified and linked together. Some candidates lost marks in calculations through carelessness in rearranging and combining formulae. Unit errors and significant figure errors were infrequent. Quality of Written Communication marks were often lost as a result of unstructured answers and very poor punctuation.

Question 1

In part (a), few candidates were able to give a concise statement of the meaning of the decay constant. Most candidates referred to the number of nuclei rather than the fraction or proportion of the nuclei that decay in a given time. Candidates quoted the equation for activity in terms of the number of nuclei often did not define their symbols. In describing two differences, many candidates realised that X has a shorter half life than Y and then went on to write about the differences in terms of the relative numbers of nuclei of X and Y, rather than the activity or the count rate or total count from each source. Candidates who compared their emissions often did not specify if they were comparing the total emissions or the emissions in a given time. Many answers were marred by ambiguities and repetition.

Part (b) (i), saw a good number of candidates score full marks, although a significant number of candidates did not correctly read the logarithmic scale for activity. Candidates who read the time scale for an activity of 100 Bq often made an arithmetical error in reading the time scale.

Most candidates in (b) (ii) scored both marks, although some candidates did not give the answer in days and thereby lost a relatively easy mark.

Many neat solutions were seen in (b) (iii). However, some candidates gave an unnecessarily lengthy calculation as a result of not using the value of the initial activity directly.

Question 2

The majority of candidates knew that the beam bent towards the lower plate in part (a), although some candidates could not give an explanation of why it did so.

In (b) (i), most candidates knew that the magnetic field exerted a force on the electrons in the beam and that this force is equal and opposite to the downward force on each electron of the electric field. Less able candidates often stated the beam was undeflected because the magnetic field is equal and opposite to the electric field or they said the magnetic field was too weak to have any effect on the beam.

Many candidates scored both marks in (b) (ii). Those who did not score full marks often could not explain the equation '$B_o e\, v = eV/d$'.

Nearly all candidates knew the correct solution and obtained the correct answer to part (c), although very few candidates adequately explained the physical basis of the equation '$eV = \frac{1}{2} m v^2$'. Some candidates used values of *e* and *m* from the data sheet, clearly unaware that they were expected to use the data in the question to calculate *e*/*m*.

Question 3

In part (a), the majority of candidates knew that radio waves are electromagnetic waves and that the current in the loop is alternating because the electric and magnetic fields of the radio waves oscillate. However, very few candidates gave an adequate explanation of why the radio waves induce an alternating current in the loop. Many candidates wrote about the loop cutting the magnetic field lines and usually were unable to refer to the magnetic field of the radio wave providing a changing magnetic flux through the loop. Some candidates thought the induced current caused the magnetic field of the radio wave.

In part (b), most candidates did not realise the radio waves from the transmitter are polarised and some candidates considered the loop caused the waves to become polarised. Some candidates did score a mark by stating the zero signal is because there is no magnetic field or flux through the loop at 90° to its initial position. Few candidates explained the decreasing or zero signal in terms of the decreasing magnetic flux through the loop as it is rotated.

Question 4

Most candidates were able to score the mark in (a) (i).

Few candidates in (a) (ii) gave a satisfactory explanation of the observed interference fringes although most did know the conditions for a bright fringe and for a dark fringe. Many candidates could not identify clearly the path of the two beams to the telescope and did not refer to the path or phase difference between the two beams.

In (b) (i), several candidates did know that Michelson and Morley thought the speed of the light beam along each arm would change on rotating the apparatus. However, few candidates appreciated that the difference in the time taken would therefore change, although some did realise that the change of speed would cause the phase difference to change. Many candidates in (ii) gave a correct conclusion.

Question 5

The majority of candidates scored well in part (a). In (i), most answers were in terms of electron diffraction by a crystal or a metal. Some candidates did score both marks by referring to high energy electron diffraction by the nucleus; although some lost a mark because they did not make clear that high energy electrons are necessary for diffraction by nuclei to be significant. Candidates who discussed electron tunnelling in the STM often did not to mention that the tunnelling takes place across the gap between a metal tip and a conducting surface at a different potential.

In (ii), many candidates gave a satisfactory description of the photoelectric effect, although not all candidates explained that each electron absorbs a single photon of light and can escape if the energy gained from the photon exceeds the work function of the metal.

Most candidates scored no more than a single mark in part (b), as very few candidates realised the need to use their knowledge of relativity in addition to the de Broglie equation in this calculation. Successful candidates mostly calculated the relativistic mass of the electron and used it in the de Broglie equation, although some candidates correctly applied the relativistic length contraction after using the de Broglie equation with the rest mass of the electron.

Mark Ranges and Award of Grades

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