Examiners' Report
Principal Examiner Feedback

January 2017

Pearson Edexcel International Advanced Level In Physics (WPH06) Paper 01 Experimental Physics

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January 2017
Publications Code WPH06_01_1701_ER*

General

The IAL paper WPH06 is called Experimental Physics and assesses the skills associated with practical work in Physics. In particular it addresses the skills of planning, data analysis and evaluation. As the questions are set in a wide variety of familiar and unfamiliar contexts, those candidates who have carried out a range of experiments using different techniques will find the paper more accessible.

This document should be read in conjunction with the question paper and the mark scheme which are available at the Pearson Qualifications website.

The paper for January 2017 was in a similar format as previous years and with much the same skills content although this, as in previous years, appeared in different questions. The topics and contexts are new each time and it is this aspect that is likely to cause difficulties for students who do little practical work. The mean mark was only slightly higher than in January 2016 which indicates that the students found this paper just as accessible as the previous series and were able to display their knowledge of practical techniques consistently.

Generally the students were well prepared and seemed familiar with all that was asked of them. As with previous series it was the planning question (question 3) that produced the widest spread of marks. The experiment presented for this question should have been familiar to those who have studied magnetic fields as a standard method to demonstrate the force on a current-carrying conductor therefore better answers were expected. The data handling question (question 4) also discriminated between the students, particularly as the graph involved logarithmic quantities.

Question 1

As in previous series, this question assessed the candidates' ability to handle uncertainties at the level expected of an A2 candidate. This question concerned determining a value of the focal length of a lens given measurements of both the diameter and thickness of the lens. Although this may have been an unfamiliar context, the majority of candidates coped well with the arithmetic aspect of this question.

Part (a) of the question invited the candidates to describe how the diameter would be measured using set squares and a ruler. It was clear from some diagrams that the candidates had never tried this or knew what a set square was. In addition, many presented an unlabelled diagram which is not good practice. Although some candidates were clear about how the instruments would be used, some left gaps between the set squares and the lens or did not sit the set squares adequately on the ruler with a suitable overlap. Also, some candidates drew the lens to measure the thickness rather than the diameter. More candidates were successful in describing how to check the uniformity of the diameter however just stating repeat and average was not enough without specifying the need to rotate the lens.

The remainder of the question involved calculating a value for the focal length and calculate uncertainties. The former was done well by most candidates however the final mark was usually lost by not giving the final answer to two significant figures to be consistent with the data or, more unusually, by giving incorrect units. It is interesting to note that often Hz was given which suggests that the candidates misunderstood the quantity being measured. The majority of candidates calculated the percentage uncertainties in the diameter and thickness, and successfully combined them into an overall percentage uncertainty. However, it was expected that the candidate should be consistent in the number of significant figures used for these calculations which the less able candidates found difficult. Those candidates that were successful in this also did well in the final part of the question where they had to identify which measurement contributes more to the uncertainty in f. Part (b)(iv) proved to be the most difficult for the candidates. It was clear that some candidates did not know how to find the absolute uncertainty in a value given its percentage uncertainty despite it being a simple percentage calculation. In addition, those that did know how to do it then did not realise that giving an answer to ±0.1 mm was not acceptable within the context of the experiment.

Question 2

This question focussed on measuring techniques set within the context of a standard experiment often used to investigate the factors affecting circular motion.

In part (a) the candidates had to list the techniques they would use to ensure the measurement of the time period was as accurate as possible. It was clear that some candidates were drawing upon their knowledge of simple harmonic motion as they would often use the word "oscillation" as opposed to "revolution" in their answers. This also made the awarding of the mark for use of a timing marker more difficult as they were unclear about where and how it should be used. This marking point was the one most often not achieved. In contrast the majority of candidates were very clear about repeating the experiment to obtain a mean value. Although the majority did describe timing multiple revolutions some simply stated that they would find an average which was not explicit enough to gain the mark. Some candidates also tried to justify the use of electronic means of timing, such as light gates, in terms of being more accurate however this did not gain any credit.

In part (b)(i) the vast majority of candidates were successful in using the given formula to derive the formula for T^2 however there were a significant number that did not correctly state the graph to plot in (b)(ii). Only the variables to be measured were expected here therefore any answers that contained a constant did not gain the mark. Many candidates did not realise that x was also a constant.

Part (c) concerned measuring the length x. The responses were disappointing as, despite being given a clearly marked diagram, the majority of candidates did not gain a mark. Of those that did gain a mark it was for realising the string had to be straight in order to be measured. Although there was often a good attempt to describe how the measurements would be taken often the candidates did not state the centre of the bung or did not specify the need for the mark to be aligned with the bottom of the tube. More successful candidates realised they could measure from the mark to the centre of the bung and subtract the length of the tube. A significant number tried to use Pythagoras theorem or use set squares.

The final part of this question concerned the safety aspects of this experiment. In general, candidates were able to identify a precaution, such as wearing goggles or protective footwear, without stating why this was necessary. In addition some candidates thought it was enough just to stand clear or keep the apparatus at arm's length without considering what might go wrong. Usually this type of question requires the candidate to identify both a risk and precaution in order to achieve the mark.

Question 3

This question tested the candidates' ability to present a structured plan however there is usually a framework in the question which the candidates can use as a guide. In this paper the experiment the candidates were asked to plan was based on a standard demonstration of the force on a current-carrying conductor. It was clear from some answers that the candidates had not had experience of this experiment and, in some cases, an electronic balance was also unfamiliar. In addition, there were a number of candidates who misinterpreted the description and gave answers that involved electromagnetic induction. Although some candidates presented some correct theory behind the experiment, this was not asked for in the question and hence not given credit.

The initial parts of the question asked the candidates to identify additional apparatus and show both a circuit diagram and physical arrangement. Better candidates were able to do this well, often gaining all of the marks available, however a significant number did not realise that a means of varying the current was required, either from a variable resistor or variable d.c. power supply. In addition some candidates identified the need for an a.c. supply which clearly would not work. In general, circuit diagrams showed a working arrangement however the quality of these diagrams was often not what would be expected at this level with some candidates not using standard symbols or presenting circuits containing gaps. Some candidates also felt the need to include a voltmeter in the circuit when there is no mention of potential difference in the equation being investigated and there were a number who connected the voltmeter in series.

The best diagrams for the physical arrangement often included a side and plan view whereas those that attempted three dimensional representations were less successful.

The final parts of the question required the candidates to write a method and sketch the graph of the expected results. The better candidates often produced a logical method however only the best candidates realised that the mass recorded on the balance needed to be converted into force. Less able candidates were convinced that the balance recorded weight rather than mass and often presented a disjointed method. In general the sketch graph was correctly identified.

Question 4

This is the data handling question that requires students to process data and plot a graph to determine a constant. In this question candidates were presented with the activity of a radioactive sample comprising two radioactive isotopes, one of which completely decaying within 15 hours. It was the decay constant of the isotope still active after this time period that the candidates were asked to determine.

The first part of the question, part (a) posed little difficulty for the majority of candidates since the radioactive decay law is familiar to those who have studied radioactivity. In general, even weaker candidates were able to manipulate the equation into a straight line form but a surprising number were still not explicit enough in comparing this to $y = \mathrm{m}x + \mathrm{c}$. The better candidates were able to express this well, usually by stating that the gradient was the decay constant.

Part (b) of this question involved processing the data and plotting the graph. The vast majority of candidates were able to calculate the natural logarithm of the activity but there were a number that only gave values to two significant numbers where three was expected. In general the graph was plotted well with only weaker candidates insisting on using a *y*-axis that began at zero. This is unnecessary at this level as it results in a graph that is too small. Scales were often chosen well however it should be noted that scales in increments of four do often result in candidates misplotting points or incorrectly interpolating values from the graph. As with previous series the units for the graph caused some confusion. A logarithm should have no units therefore both the quantity and unit should appear in the bracket, e.g. ln(A/Bq). The best fit line for this graph caused the greatest problem for the majority of candidates. This should have been a smooth curve until the 15 hour mark and a straight line thereafter. Many candidates either drew a curve or straight line along the entire length. As a result, only the better candidates gained credit for calculating the gradient of the straight line section. In this part, candidates sometimes failed to gain the final mark as the final answer was given to too many significant figures or with a unit based on both Bq and hour^{-1}.

Summary

Candidates can improve their chances of gaining a good mark on this paper by routinely carrying out practical activities for themselves using a wide variety of techniques. These can be simple experiments that do not require expensive, specialist equipment and suggested practical activities are given in the specification. Planning an experiment is a skill many candidates find difficult therefore it is recommended that candidates practise this sort of task and develop an idea of structuring a plan.

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