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

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General

The IAL paper WPH06 is called Exploring Physics, and is closely tied to the Internal Assessment GCE unit 6PH06 for UK centres using the GCE Physics 2008 specification. It assesses the skills associated with practical work in Physics and addresses the skills of planning, data analysis and evaluation. Set in a wide variety of contexts, the questions will be more accessible to those students who have, themselves, carried out a range of practicals in the laboratory. A plan at this level will consist of several stages and there are questions concerning choice of apparatus, and the use of that apparatus, that will be immediately familiar to those with the practical work experience.

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 2016 was in the same format as previous years and with much the same 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.

Generally the students were well prepared and seemed familiar with all that was asked of them, and again this series it was the planning question, question 2 that they found difficult. Although the burette might not be familiar to Physics students the introduction to the question contained a description and a diagram of a burette which seemed to help many students. The data handling question, question 4 also discriminates between the students.

The mean mark was nearly two marks higher than in January 2015 which indicates that the students found this paper a little easier, perhaps because their skills are improving. A number of students did not gain marks because they tried to apply techniques learned from previous papers to questions in a different context. In general, causes of uncertainty and precautions for accuracy should be discussed in the context of the question and not presented as generic statements, such as parallax or human reaction time – these must be applied to the specific question each time.

Question 1

This question asks students to justify choice of apparatus and describe its use and then to process data, including uncertainties, to daw a conclusion about the material from which two 'rubber' objects are made – an elastic band and a rubber bung.

(a)(i) Students are asked to explain why a metre rule is suitable to measure the length of the band. We expected answers that gave the percentage uncertainty introduced by using this instrument, so they should state the precision and calculate the percentage uncertainty based on the approximate length of 10 cm stated in the question. It is an 'explain' question so a bald percentage uncertainty = 1% scored zero. In (a)(ii) students have to calculate the volume of the band by substituting numbers into the equation given; they are required to use appropriate units and significant figures. This was done quite well but many student were not awarded a mark because they used more than 3 significant figures.

In (b)(i) many students described using a metre rule to measure the bung despite the fact that the question states that callipers will be used. The most able students used a diagram to show how the callipers would be fitted around the bung and there was a mark for a suitable precaution such as not compressing the bung. Many answers addressed the vertical bung, which clearly referred to the diagram in the question and helped students to explain themselves.

(b)(ii) asks for a calculation but the formula was more complicated than (a)(ii) and some students forgot to complete the calculation by multiplying by ($\pi h/12$).

In (b)(iii) students are told that D and d are measured with negligible uncertainty so the percentage uncertainty in V_2 is the same as the percentage uncertainty in h. Most students appreciated this but some wrongly tried to include the uncertainty in D or d.

(c) Students had to calculate the densities and give their answers with appropriate units using 3 significant figures (SF) – 3 SF are required for the answer because all the data is to 3 SF. We accept kg m^{-3} or g cm^{-3} so long as the powers of ten are correct.

(d) mentioned the percentage uncertainty in the density of the band as 4% and students tended to ignore the 0.57% from (b)(iii). Students can either calculate the percentage difference between their two values and compare this with the total percentage uncertainty or they can use the range method. In the first method they should use the mean value of the two densities since neither is a definite number but only the result of their measurement; in the range method they should calculate the spread in their two readings by applying the uncertainties to each and then seeing if the ranges overlap. In this question the densities were far apart in value but such a comment must be supported by data if the student is to get the mark.

In general, parts (c) and (d) were done well by most students.

Question 2

This question tests planning skills and as a revision exercise it is recommended that students practise this sort of task and develop an idea of structuring a plan. There is usually a framework in the question and the more able students find it a help to use this as a guide.

This time the equipment used was a burette and this was clearly unfamiliar to a number of students. The question begins with a description of the device and a diagram but this did not help some students.

Most students described measuring the time with a stopwatch but many were not awarded the second marking point because they did not describe a method. What was expected was a brief description of either measuring the time taken for various volumes of water to run out of the burette or for measuring the volume of liquid to run out in successive time intervals. Marks were awarded for precautions such as each volume or time being repeated for a mean value, but the precautions and the uncertainty had to be expressed in the context of the question. Students often said 'reaction time' or variants which by itself gets no credit, similarly for parallax. Students were expected to describe how they might try to use both instruments simultaneously or appreciate the effect of the volume of liquid below the tap.

Part (a)(iii) was answered well but a large number of students did not answer the specific question which asked them to state which graph they would plot.

In part (b) students were expected to mention the effect on the liquid of reducing the viscosity rather than mentioning only the change in the resulting graph. This was a question in which it is easy to become confused and chose the wrong one of the two alternatives.

Question 3

Drawing a diagram is a distinct skill that is very useful in Physics exams and beyond, so too is taking information from a diagram. Generally the standard of diagrams was poor. Students should bring a ruler into the examination and should have practised using one. The difficulty in this question is mixing the electric circuit with a diagram representing a water bath and heater. Components should be identified either by using a standard symbol or by labelling the diagram. Since the question asks how this experiment might be done in a school laboratory students should give specific labels for each item, so that 'heat source' is not sufficient but rather 'Bunsen burner' is expected. Similarly the diagram should give an idea how the equipment is to be used, so leads cannot pass through the walls of the beaker and thermometers must be very close to the item of which they are measuring the temperature. A mark was given for showing how the resistance might be measured and it was surprising how many students could not apply a piece of GCSE knowledge. In practice an ohmmeter is the easiest way to do this.

In part (b) many students did not pay attention to the exact wording of the question, so in (b) (i) 'extra readings in the range' meant more readings to fill the gaps. In (b)(ii) the word 'how' is used when requiring a brief description, so using ice to lower the temperature is the sort of response required.

Question 4

This is the data handling question that requires students to plot a graph. This time the logarithmic graph appeared in question 2 and in this question students had to plot time period squared against mass. It is not necessary to show the origin on a graph and to do so with this data and grid results in a scale that is too small. As shown on the mark scheme starting at 2.5 spreads the points out across the paper. Many scales were too complex to enable accurate plotting, interpolating or gradient calculation. Most students who squeeze the plots across the page with a complex scale loose marks because they make mistakes reading their own scale. This question asks them to determine the gradient and then use the intercept as well to determine numerical values for characteristics of the system such as spring stiffness and mas of the trolley.

In part (d) students were expected to base their conclusion on their numerical data. Thus they should calculate the percentage difference between the values and comment on the result in terms of the likely uncertainties in the measurements.

Many students measured the gradient and thought it was equal to the stiffness k, students also lost marks by ignoring the unit for k. The value for M can also be obtained by dividing the intercept by the gradient, few students used this. This is another question in which students can improve their scores by practising the techniques required.

Many students can improve their scores by practising their diagrams and graph drawing but most of all by carrying out practical work for themselves, it should not be expensive or complex.

Summary

Future candidates could improve their results by having more experience in planning practical work and by drawing more graphs and then using the results to evaluate the outcome. All candidates will benefit by seeing and doing practical work however simple.

Grade Boundaries

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http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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