OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL PHYSICS

(9630) PH05 Physics in practice
Report on the examination

January 2022

REPORT ON EXAMINATION: INTERNATIONAL A LEVEL PHYSICS (9630) PH05 PHYSICS IN PRACTICE – JANUARY 2022

This paper has two sections. In section A students were tested on practical procedures and data analysis. Each of the three questions in section B used a single context to test a range of topics from the whole specification. In this way students are given many opportunities to demonstrate their knowledge, understanding and skills across all four assessment objectives.

In general, mathematical questions were often answered well. Careless errors with significant figures and rounding, for example, were common. Sometimes it was difficult to identify the number in an answer because it was written in a careless way. Answers were not credited when values were obscured in any way. Care should be taken with minus signs in negative indices, for example.

The questions that required extended writing and the use of precise scientific language were not generally answered to a high standard. There is an expectation at A-level that students should be able to use appropriate scientific terminology with confidence.

Students generally performed better on questions that assessed AO2 and the data-analysis aspects of AO3. Performance in AO4 was more variable. The evaluative aspects of AO3 require a clarity of writing that many students failed to achieve.

SECTION A

QUESTION 01

Most students read the vernier scale and then determined the absolute uncertainty correctly in parts 01.1 and 01.2.

The calculation of the percentage uncertainty in 01.3 caused more difficulties. Marks were lost by students who gave their answers to more than two significant figures, for example.

Careless errors in 01.4 also cost marks. Several students provided the correct equation for the volume of a sphere but did not cube the radius or halve the diameter. Limiting the number of significant figures to reflect the practical aspects of the question was also missed by some students.

Most students made some progress with 01.5 but relatively few received full marks. The best answers set out their working clearly and gave an answer to the same number of decimal places as their answer to 01.4. This demonstrated their understanding of the relationship between the absolute uncertainty and the precision of their final answer.

QUESTION 02

Throughout this question errors were carried forward so no marks were lost due to an error in a previous part.

Very few mistakes were seen in 02.1. Only occasional carelessness, perhaps through transcription error, prevented everyone getting the mark.

In order to assess 02.2 examiners had to be able to see the plotted points. Where error bars are not involved, students should be encouraged to use a $+$ or $\times$ to mark the points on a graph. More care also needs to be taken when drawing a best-fit line. Students were penalised for multiple lines and lines that were too thick.

Students had to demonstrate a range of skills to obtain full marks in 02.3. In a gradient calculation, examiners expect to see the data taken from the best-fit line. The use of data points not on the line, or

simply writing down an answer, does not get credit. Students need to *demonstrate* the use of a large triangle to arrive at their value.

In 02.4, most students understood how to obtain the value for C_0 from the intercept. The alternative use of the equation was also credited, provided it was clear that an appropriate point on the line had been used.

There were several ways to approach 02.5, all of which gained credit. It was helpful when students who used the graph to arrive at their answer showed clearly what they were doing. Significant figures were again a problem for those students who gave no thought to the meaning of their value.

The most straightforward way to answer 02.6 was to multiply the answer to 02.5 by 5. Students who chose to work out the value from first principles were also given full credit.

QUESTION 03

It was clear in 03.1 that many students believed that the output power should be controlled by a variable resistor on the primary circuit. The best answers showed correctly connected meters on both sides of the coil, with an ac source on the primary and a variable resistor on the secondary.

The bullet points in 03.2 should have made it easier for students to gain marks. Having six marking points with a maximum mark of 5 also made the question more accessible. There was a good spread of marks across the mark range and the question discriminated well. The best answers were set out logically with each step in the process made clear, and meters and measurements identified. It was expected that a graph of efficiency against output power would be suggested but students were rewarded when they suggested plotting output power against input power and made it clear how the efficiency could be determined.

QUESTION 04

In order to gain full marks for the derivation in 04.1, students needed to set out each step carefully and clearly. Students who required the examiner to fill in any algebraic steps lost marks.

A major issue with 04.2 and 04.3 was related to untidy work. Students commonly used a broad pencil to mark off a small error bar. When this was combined with broad drawn lines, it was difficult to judge whether the error bars had been used correctly. In such cases students were not given benefit of the doubt.

Most students found 04.4 to be very straightforward.

There were many creditworthy approaches to answering 04.5 and therefore a generic mark scheme was adopted. It was expected that students would use the range of intercepts from their two lines to determine whether the theoretical value of e was consistent with that range. Despite the alternative ways of obtaining full marks, very few students managed to do so.

In 04.4, the calculation was completed correctly by most students. The mark scheme was broken down into clear steps that allowed almost all students to gain some credit.

The calculation in 04.5 proved to be more challenging, perhaps due to the context rather than difficulties with the physics.

In 04.6 students were required to be very precise about the improvements that could be made to the method. Given the nature of the data, vague answers such as "*use a large value of L"* were not given credit unless it was clear how that was related to the reduced uncertainty in *v* and e. Students were expected to make some reference to the improvement in the range or distribution of the points on the graph. The second marking point was for suggesting a method of improving the measurement of *l*; this was rarely seen. Students should be warned to avoid writing general answers to very particular questions.

SECTION B

QUESTION 05

05.1 produced a good spread of marks and discriminated well. Most students were able to show the required calculation. An adequate explanation of equilibrium was seen much less often. Some students failed to get this mark because they suggested there was no force, rather than no *resultant* force, acting.

The straightforward calculation in 05.2 was completed successfully by most students.

In 05.3, the best answers made it clear how the graph was being used to arrive at the answer. Partial credit was given for incorrect answers that demonstrated an understanding that an area of the graph was needed.

To answer 05.4 students had to understand the meaning of “average” in the question. The tension in the top of the rope was due to the person and the rope. The tension at the bottom was only due to the person. It was the average of these two tensions that was required. Students were required to show clearly what they were doing to gain the marks in this “show that” question.

05.5 was answered correctly by the majority of students. This question produced a spread of marks and discriminated very well.

QUESTION 06

Most students produced the straightforward calculations required in 06.1 and 06.2 .

In 06.3, most students understood that the diode would only allow a current in one direction, but few could explain its role with reference to the behavior of the circuit and the discharge of the battery at night.

The mark scheme in 06.4 allowed for a range of values in the current for the first marking point. The second marking point included a quality mark for the power using a narrower range. Despite this, most students who managed to get the first mark also got the second.

It was clear from answers to 06.5 that many students knew which region of the graph was important for their answer and therefore received the first marking point. Very few were able to explain their choice satisfactorily, however. Similarly in 06.6, many students were able to determine the number of diodes, but very few were able to complete the associated explanation. Whilst it is important that students are confident in the use of mathematics, they also need to be prepared to answer explanations of this kind.

QUESTION 07

The calculations in 07.1 and 07.2 were generally completed very well. There was some confusion in 07.2 from students who did not understand the kelvin as the unit of temperature difference, and added 273 to their answers.

In 07.3, full marks could not be given when answers were unclear as this was a “show that” question.

Most students struggled to make any progress with 07.4. The best answers were set out logically, explaining how the rate of change of momentum of the steam was related to the reaction force on a nozzle, and how the line of action of this force resulted in a torque. Many students simply made references to Newton’s 3rd law of motion, and to moments, without demonstrating any understanding of the context.

Despite the mixture of units in 07.5, many students coped well with this calculation and were given full marks. The mark scheme meant that students who made an error could receive partial credit when it was clear what they were doing.

Students unfamiliar with the idea of a force being associated with a rate of change of mass and constant velocity made little progress with question 07.6. Most were able to work out the force and get no further.

The best answers to 07.7 approached the question logically, making it clear what part of the graph was being used and how it was being analysed. They also stated clearly the unit conversion that needed to be carried out.

Many answers to 07.8 made vague references to resonance without any detailed discussion of this context. The idea that energy was being transferred to the kinetic energy of the vibrations rather than rotational kinetic energy of the cylinder was very rarely seen.

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