OXFORD

INTERNATIONAL AQA EXAMINATIONS

INTERNATIONAL AS LEVEL PHYSICS

(9630) PH02 – Electricity, waves & particles
Report on the examination

June 2022

REPORT ON EXAMINATION: INTERNATIONAL AS LEVEL 9630 PH02 JUNE 2022

This examination was very similar, in terms of demand and coverage, to those set in previous years. Students had many opportunities to demonstrate their knowledge and understanding in many different areas of the specification.

As in previous years, mathematical questions were generally answered better than those requiring extended writing. In particular questions that required students to ‘explain’ were often poorly answered, lacking essential detail.

Student performance was seen across the full ability range.

QUESTION 01

The best answers to 01.1 made it clear that a superconductivity happens below, and not just at, the critical temperature.

Fully correct answers to 01.2 were very rare. Many students simply stated that strong magnets require large currents without referencing the advantage of using superconductors for this.

QUESTION 02

Most students were able to identify the emf and terminal pd, but explanations were often vague and incomplete. Few students demonstrated knowledge of their definitions in terms of work and charge.

QUESTION 03

The calculation in 03.1 was answered well, with most students being able to make some progress with it. Rounding errors were relatively common. Students should be told to carry forward the full intermediate values and only round in the final answer.

Most students were able to get one mark for the first step of the calculation in 03.2. The most common approach was to determine the critical angle, but a demonstration that an angle of refraction was impossible was also given full credit. This question discriminated very well.

03.3 produced a good spread of marks and also discriminated well. Marks were lost by students who did not provide sufficient detail in their explanation or diagram. A common error was to suggest that, at some point, the ray was incident on the water surface along the normal. This is clearly not the case, looking at the shape of the wave.

QUESTION 04

In 04.1 examiners required the students to refer to wavelength or frequency rather than colour.

Most students were able to pick up one mark in 04.2 by referring to material dispersion, but few went on to explain their answer.

There were several routes that allowed credit in 04.3 and most students obtained at least one mark, often for suggesting that the diameter should be reduced. Full answers that explained the change were very rare.

QUESTION 05

Question 05.1 referred to the energy, but many students incorrectly used terms such as ‘*ground state*’ or failed to use the energy scale to help their answer.

Arrows starting at the ionization level were not condoned in 05.2. The best answers were straight lines, drawn with a ruler, with a clear downwards arrow going from one energy level down to $n = 1$. Answers that did not reach the line were not credited.

The multi-step calculation in 05.3 gave credit for partial answers and discriminated very well. Students should be told to set out their answers clearly so that intermediate steps can be rewarded. Some students failed to identify the lowest energy jump, or did not convert their eV to J correctly.

QUESTION 06

Part 06.1 was a 'show that' question, with students being given a relationship to aim for. This produced an excellent spread of marks and discriminated extremely well. Only students who set out their answers step by step from first principles were given full credit.

Students were expected to use the de Broglie wavelength to answer this question. Students who did not spot this made little progress. Many answers using the mass of the electron and the speed of light were seen.

Examiners expected students to state their assumption that the gap size was similar to that of the wavelength. This was rarely seen and was largely dependent on using the de Broglie approach in 06.2.

Students were given credit for the use of their momentum from 06.2. With only one mark to award, students who did not get an answer consistent with their value obtained no credit.

QUESTION 07

Although many students were aware that the resistance decreased, answers that did not cover the full range of temperature, or lines that reached the temperature axis, did not get credit.

07.2 was also answered correctly by most students. Those who had difficulties often failed to spot that they needed first to work out the vertical displacement from the machine to the top of the motion.

Although question 07.3 produced a good range of marks, full marks were rare. Students commonly failed to indicate how the temperature could be varied, or did not mention the need for a thermometer. Students who followed the bullet points carefully tended to do better.

QUESTION 08

The meaning of 'coherent' has been asked many times and it was clear that many students were familiar with the answer. One common error was to state that sources were in phase, rather than having a constant phase relationship or phase difference. Answers that suggested extra constraints, such as the same amplitude, also failed to get full marks.

Many good answers to 08.2 were seen. Students who referred to superposition and correctly identified phase and path difference tended to score very well.

The calculation in 08.3 discriminated well but full answers were rare. A common error was to assume that the waves were in phase at B. Although the use of the double-slit equation was condoned, the geometry meant that a Pythagoras approach was more appropriate. It may be that in the future only the Pythagoras approach will receive full credit for situations like this.

Most students found 08.4 and 08.5 very difficult. Answers highlighted the conceptual difficulties of dealing with phase and path differences correctly. Students who identified A as the central maximum and B as a minimum tended to do better.

QUESTION 09

Practical familiarity with potential-divider circuits was very helpful when answering question 9.

Fewer than half the students knew that a null reading meant that the pd was zero in 09.1. The students continued to have difficulties with many aspects of this question.

The uncertainty calculation in 09.2 is a very common requirement, and the method is independent of the context. More practice with practical questions of this kind would benefit many students.

Many students did not attempt 09.3. They may have missed the command sentence. Students must be told to read examination questions carefully. The construction of the best fit line in 09.4 was done well by most students, but a careful reading of the mark schemes shows what is expected of students when they draw lines of best fit.

Examiners expected the students to use the gradient of the line to answer 09.5. Students who based their answer on one point were not given full credit.

QUESTION 10

Most students were able to apply the resistivity equation in 10.1 and obtain full marks. For others, a common problem was distinguishing between the dimensions of area and length.

In 10.2, one mark was obtained for identifying what happened to the voltmeter reading, and this was gained by most students. The accompanying explanation mark was harder to award, with many students struggling to identify which resistor they were describing.

The calculation in 10.3 was very straightforward and was usually answered well. Students struggled with 10.4, perhaps because they were unwilling to consider the answer may be '*no effect*'.

SECTION C

The easiest multiple-choice questions were C14 and C20.

The hardest were C16, the inverse-square law gamma-ray question and C24, the photoelectric-effect question.

In C16 the most popular answer was C, followed by D. Students failed to square, and failed to use the factor of 4π . In order to answer this, students should consider the surface area of a sphere.

In C24 B was a very popular alternative. Students should be familiar with the photoelectric effect in graphical terms.

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In line with OxfordAQA's Fair Assessment promise, the assessment design, marking and awarding of this examination focused on performance in the subject, rather than English language ability.

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