OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL AS/A-LEVEL PHYSICS

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

January 2022

REPORT ON EXAMINATION: INTERNATIONAL A LEVEL PHYSICS (9630) PH02 ELECTRICITY, WAVES AND PARTICLES – JANUARY 2022

The demand and style of questions in this paper were consistent with those of previous series. The wide range of question styles provided students with many opportunities to demonstrate their knowledge and understanding on a variety of topics.

Mathematical questions were often answered well. There is evidence to suggest that some students do not take sufficient care with their work, however. Rounding errors were surprisingly common, and numbers themselves were frequently illegible. Benefit of the doubt is at the discretion of the examiners and students who write the number “9” as a letter “P”, for example, are likely to lose marks.

Questions that required extended writing and the use of precise scientific language proved to be more challenging. Ambiguous or unclear answers were not rewarded. Some discussions and explanations referenced only basic knowledge or understanding and were below the standard expected at AS level.

Students generally performed well on questions that assessed AO2 and the data-analysis aspects of AO3. Performance in AO4 was more variable, probably because it is dependent on how familiar the students are with the particular practical context. Performance in AO1 and the evaluative aspects of AO3 depend on the clarity of writing and many students struggle to express themselves with clarity.

SECTION A

QUESTION 01

Most students had little difficulty with these straightforward one-mark calculations.

With only one mark, examiners could not give partial credit. Careless mistakes, due to rounding errors for example, meant that otherwise correct answers did not get the mark. Similarly answers given to only one significant figure were not given the mark.

QUESTION 02

This four-mark calculation discriminated very well and gave a good spread of marks. Most students knew that they had to use the diffraction-grating equation. Identifying the important data from the question was more of a challenge. The most common error was a failure to divide the angle in the question by 2 to get the diffraction angle. There was also some confusion between the number of lines per metre and the separation of the lines. Students who had some awareness of the wavelength of visible light could check their answer and correct these and similar errors.

QUESTION 03

Most students found this question very difficult, with the majority getting no marks. The idea that the sources were not coherent was sufficient for one mark, but it was very rare to see any worthwhile discussion beyond this. Responses suggest that this is not an area that is well understood.

QUESTION 04

Most students were unable to pick up any marks on this question. Many students chose to provide descriptions of the photoelectric effect, for example. For the first mark examiners were looking for some reference to line spectra. It was very rare to see answers providing the necessary detail to explain how the line spectra provide evidence for discrete energy levels. An example of lack of clarity was seen in answers that suggested that photon energy was somehow linked to the energy levels themselves rather than differences in energy levels. Very few students were able to make the link between the limited number of photon frequencies and energy-level transitions.

QUESTION 05

The single mark calculations in 05.1 and 05.2 were answered well by the majority of students. As these were ‘show that’ questions, students were expected to set out their answers clearly and give the final answer to at least one significant figure more than that provided in the question. Setting out answers clearly is good practice for all questions. In calculations like these, students should write down the equation they are using in symbols, make the substitution and/or manipulation of the equation, before writing out their final answer clearly.

05.3 proved to be much more challenging for many students. Few of those who knew that the electron wavelength was closer to the atomic spacing were able to go on to explain why this makes it a better method. Vague references to “*better diffraction*” were not credited, for example.

QUESTION 06

Answers to 06.1 often lacked sufficient clarity to gain marks. There is a clear sequence of events that lead to the production of visible light in the fluorescent tube, but in many answers the different roles played by the mercury and the phosphor were poorly understood. The idea that the phosphor de-excites in several steps so that lower-energy photons are emitted was rarely seen.

Many answers to 06.2 used ideas related to resistance in semiconductors. The idea of an increase in charge carriers was only sufficient for one mark, however. The process was commonly linked to an increase in temperature, rather than a discussion of the collisions in the tube. Many students were unable to make any progress with this question.

QUESTION 07

The majority of the students answered 07.1 correctly. The drawing in 07.2 was much more challenging. With only one mark available, careless lines in terms of amplitude or shape were not rewarded, even when the phase was correct.

The majority of marks in 07.4 were given for the explanation. The best answers mentioned superposition and explained it clearly. Many answers were seen that referred in general terms to interference and gained little credit.

QUESTION 08

The calculations in both parts of this question were carried out well by many students. The questions provided a good range of marks and discriminated well. In 08.1, some students had trouble reading the log scale in order to determine R_L but were able to pick up marks for other parts of the answer. Students who set out their answers clearly were more likely to be awarded these compensatory marks.

QUESTION 09

It was clear that many students do not read questions carefully before starting their answer. It was very common to see answers that assumed that H was the length of the pendulum, for example. Other incorrect answers simply suggested that H should be measured with a metre ruler.

The analysis in 09.2 also proved to be a problem for students who interpreted the equation with H and g as variables rather than constants.

QUESTION 10

This question was designed to assess the students’ ability to apply their knowledge and understanding to an unfamiliar context.

10.1 proved to be one of the most challenging questions on the paper. Many students who made some progress by referencing Newton’s first law of motion could not apply it sufficiently clearly to be given the one mark available.

Although many students received one mark for 10.2, few were able to make much progress beyond working out the time for the wave. Incorrect answers were able to gain partial credit if the working was sufficiently clear.

10.3 was the most accessible part to this question, and students who managed to make a start tended to get full marks. Some answers from students who made less progress appeared to interpret the charts as the waves themselves that were setting off from P.

In 10.4, many students understood the significance of the difference in amplitude. Fewer were able to satisfactorily explain this in terms of attenuation. Some students missed the word ‘other’ in the question and simply repeated the information they had been given.

SECTION B

QUESTION 11

The ‘show that’ calculation in 11.1 was correctly provided by the majority of students. The most common error was due to writing the answer to insufficient significant figures (sf).

11.2 discriminated very well and produced a good spread of marks. In practical questions of this kind it is important to understand the relationship between the determined value and its absolute uncertainty. It is expected that the precision of the two numbers should be the same. Therefore, the two answers need to be quoted to the same number of decimal places.

11.3 provided little challenge for the majority of students. It is important to stress, however, that the data used to determine the gradient should be clear. When a large triangle is not drawn on the graph, the values quoted in the answer need to be from points that are far apart.

Difficulties with expression and clarity of language meant that very few answers to question 11.4 were given both marks. It was clear that many students only vaguely understood the advantages of a graphical analysis.

QUESTION 12

The power calculation in 12.1 was very straightforward and answered correctly by most students.

The use of the resistivity equation in 12.2 was only marginally more demanding. In a practical question of this kind students are expected to give some thought to the significant figures in their answer. Answers given to 3sf could not be justified because of the precision of the data provided, so any number greater than 3sf was penalised.

12.3 produced a good spread of marks and discriminated reasonably well. The main issues appeared to be with the circuit diagrams. Despite being given the symbol for an ac supply many students also added a dc battery, for example. Many students were also unsure about where to put the lamp in the circuit.

The calculations were generally done better than the circuit diagrams; each point was marked independently.

SECTION C

Most of the multiple-choice questions were answered correctly by the majority of students. Questions 15 (diode network) and 13 (standing wave on string) were answered particularly well.

The most demanding question was 19 on interference of sound waves. The most popular wrong answer was C. Questions 21 and 22 were also answered incorrectly by the majority of students. The most popular wrong answer in 21 was D and the most popular wrong answer for question 22 was C.

GET HELP AND SUPPORT

Visit our website for information, guidance, support and resources at **oxfordaqaexams.org.uk**

FAIR ASSESSMENT PROMISE

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.

OXFORD
INTERNATIONAL
AQA EXAMINATIONS

OXFORDAQA INTERNATIONAL EXAMINATIONS
GREAT CLARENDON STREET, OXFORD, OX2 6DP
UNITED KINGDOM

info@oxfordaqaexams.org.uk
oxfordaqaexams.org.uk