OXFORD
INTERNATIONAL AQA EXAMINATIONS

INTERNATIONAL AS LEVEL PHYSICS

(9630) PH02 Electricity, Waves and Particles
Report on the examination

January 2020

REPORT ON EXAMINATION: INTERNATIONAL AS LEVEL PHYSICS 9630/PH02 UNIT 2 JANUARY 2020

This paper was accessible to students, with a broad range of marks awarded and a good standard deviation in the marks. There was no evidence that students were short of time. As in previous series, students did particularly well in Section B (multiple choice).

Students performed well in calculation questions, especially when only one equation had to be used(2.2, 4.2, 6.1, 6.2). Students also performed well in questions where data were taken from a graph or diagram and processed (4.2, 5.2, 8.2, 8.3). Students were less successful in longer questions (four or more marks) where they were asked to 'explain' or 'describe and explain', (7.4, 8.4). Many students provided a description with no explanation and so could not access all the marks. This cohort performed somewhat better than in previous series when confronted with questions involving the calculation of gradients and uncertainties (questions 5 and 10). There continue to be general weaknesses in the treatments of errors and uncertainties, however.

Students also performed less well in straightforward questions involving definitions (2.1, 8.1). Such questions often appear as the first of a series of questions within one context and students are advised to prepare more thoroughly for them. Students performed well in topics involving electrical circuits (questions 3 and 8) but less securely in topics involving photons, waves and energy levels (questions 1, 5, 7).

Question 1

This question was not well answered, with only 20% of students achieving full marks in question 1.2. Students commonly confused excitation and ionisation. In question 1.2, some students treated the ionisation level as an energy level that can be populated, leading to an incorrect answer of 10.

Question 2

This question yielded a wide spread of results. The straightforward definition question (2.1), was poor with less than half scoring the mark. Critical angle must be related to an angle of incidence, and many students omitted this fact even though the rest of their statement was broadly correct. The following question (2.2) was better answered, although many students struggled to use the equation for critical angle between two different media (where neither is air); they treated the second medium as air.

Question 3

This question was well answered against the general trend of longer explanation questions. Students expressed their ideas clearly and most attempted to state their answer and then to explain it. Over half of the cohort scored at least three out of four marks. The explanation marks were conditional on correct statements. Those students who did not score highly often made incorrect statements (e.g. stating that V_2 decreases when, in fact, it stays the same).

Question 4

In question 4.1, some students chose to explain why discrete wavelengths are emitted from a neon lamp, without reference to the diffraction grating. A small number thought that a description of practical arrangements was required. Of those students who understood the requirements of the question, explanations were sometimes too vague to be awarded full credit; in questions of this type the expectation is that an equation will be quoted and discussed as part of the explanation. Question 4.2 was much better with over half the cohort scoring full marks and three-quarters scoring at least two out of three marks. Most students knew which equation to use, although a few made power of ten errors.

Question 5

Questions 5.1 and 5.2 were well answered but students were less successful in 5.3. For question 5.1, an algebraic derivation, most students showed their workings clearly and rigorously. Some did not begin from the correct equation and gave up; others did start correctly but combined several algebraic operations in one line giving insufficient evidence of their reasoning to gain full marks. Students are advised to show only one operation per line (in this case squaring, rearranging, and substituting). Question 5.2 was similarly well answered with over half scoring full marks; a power of ten error being a common failure point. Some students took only one reading from a single datum point, when a gradient was expected. The third part (5.3) was poorly answered; many students appreciated that the ruler was too short and would have to be used three times, but few went on to say that this would increase the uncertainty of the measurement. A significant number suggested that a tape measure is more convenient because it is flexible; this is not an advantage in this context.

Question 6

Over two thirds scored full marks in each of questions 6.1 and 6.2. Question 6.3 was slightly more difficult but, even so, over half scored at least 3 out of 4 marks. Most students used the diffraction grating equation and knew that $n = 2$ in this case, but some did not know how to calculate the de Broglie wavelength of the electron. When in doubt students are advised to look back to previous parts of the question to help them decide what to do next. In this case, the momentum of the electron had been calculated in question 6.2, and it was required for the calculation of de Broglie wavelength in 6.3.

Question 7

This question was poorly answered, except for question 7.2. In question 7.1, another straightforward definition, less than a third of students scored full marks. Question 7.2 involved a calculation and a unit conversion which was well answered, with over two thirds of students scoring full marks. however, in question 7.3 only one in four students scored full marks. Few could relate total power to the photon energy. A significant number appreciated the need to divide total power by energy, but then chose the work function instead. Question 7.4 was also poorly answered, with only one in ten students scoring full marks. Many attempted a description and explanation of the effects, however they could not relate the total power to the number of photons (and therefore photoelectrons) per second. More students understood that the photon energy and therefore photoelectron kinetic energy were reduced.

Question 8

This question was well answered, with the topic of electrical circuits apparently a strength of the cohort. Fewer than half the students were successful in question 8.1 with quoting the required definition. Question 8.2 was very well answered, with five in six students scoring full marks. One failure point was to take a gradient of a tangent to the *V-I* curve, which does not give the resistance; this is a frequent and serious error. Question 8.3 was also well answered with most students scoring the first two marks for a calculation of power. Few went on to give the unit in fundamental (base) units correctly. Question 8.4 yielded a large spread of marks. Students appeared to understand the question and expressed themselves clearly but demonstrated an incomplete understanding of the respective voltages and currents of the lamps in this arrangement. Fewer still could relate these currents or voltages to a difference in resistance by referring to the *IV* characteristic.

Question 9

This question was well answered, especially parts 9.1 and 9.3. 85% of students scored full marks in question 9.1, and unless it was blank, students were generally successful. Question 9.2 was less well answered; the majority identified a resonance effect, and most attempted to explain the cause. However, many students gave a generic answer without referring to the specific context, and so were limited to two out of the three marks. Question 9.3 only required a straightforward calculation. A small handful of students attempted to use the wave equation for the speed bumps, treating them as a wave; this is invalid and full marks were not credited.

Question 10

This question was poorly answered and students found it to be the most difficult question on the paper. However, a minority of able students gave very rigorous and well-structured answers, scoring close to full marks throughout the question. In question 10.1, some students struggled to take a direct measurement from a diagram in the paper, although they were reminded in the rubric (page 1) that a ruler was required. Although most students did attempt to take a direct measurement, many demonstrated poor technique by measuring only one fringe width, or by taking the mean of several individual fringe widths. The correct method is to measure the full width of nine gaps; a quarter of students did this correctly. In question 10.2, most students were able to convert an absolute uncertainty into a percentage, but few (again around a quarter) identified the correct absolute uncertainty, even when an error carried forward was allowed. Question 10.3 was slightly better answered, with over two-thirds scoring at least 1 out of the 2 marks. A significant proportion left this part blank, having struggled with the previous parts of the question. Students should be advised not to leave sections blank, but to use their result (or the 'show-that' figure) from a previous part of a question, as each question is marked separately and a mistake is not penalised twice. Question 10.4 was not well answered, but almost half of the cohort did understand how to combine the percentage uncertainties.

Section B – Multiple Choice Section

As with previous cohorts, students scored higher on average in this section.

Question 11
A well-answered calculation from the electrical circuits topic.

Question 12
Some students thought that the resistance doubled. The combination of percentages is often difficult for students.

Question 13
This was poorly answered. More students opted for C than the correct answer, thinking that adding steel would reduce the resistance of the superconducting cable.

Question 14
Another straightforward electrical circuits question.

Question 15
Just under half were successful as many chose D incorrectly, not understanding the significance of negligible internal resistance.

Question 16
An straightforward algebraic manipulation of electrical-circuit equations.

Question 17
Some chose D, thinking that the mass of a pendulum affects its speed. About half answered correctly.

Question 18
Just under half were successful. Distractor B was popular; it is a familiar kinetic-energy graph which has the wrong x-axis here.

Question19
This straightforward recall question was well answered.

Question 20
It was pleasing to see this well answered as it is a contextual polarisation question involving intensity graphs.

Question 21
As in question 5.1, algebraic derivations seemed to be a strength with this cohort and this applied to this derivation of the diffraction-grating equation.

Question 22
It was pleasing to see good success here because previous cohorts showed only partial knowledge of dispersion in optical fibres.

Questions 23 and 24 were well answered.

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

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

enquiries@oxfordaqaexams.org.uk
oxfordaqaexams.org.uk