OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL AS PHYSICS

(9630) PH02

Report on the examination

January 2024

REPORT ON EXAMINATION: INTERNATIONAL AS PHYSICS PH02 JANUARY 2024

This paper was accessible to students and discriminated well. The mean mark was just above 40; there were no indications of time constraints. The cohort answered calculation questions better in general than those requiring written explanations, particularly for those concerning quantum phenomena (01.2, 03). Two straightforward recall questions (05.1, 07.1) were surprisingly poorly answered.

QUESTION 01

01.1 Nearly 80% of students gained both marks in this photon-energy calculation.

01.2 The first two marks of this question about fluorescence discriminated well. For these, students had to describe the excitation and de-excitation processes in terms of photons and atoms. The third marking point, specifically about fluorescence, was often not precisely expressed. Phrases such as "*de-excites in steps*" was commonly seen. Too many students described the production of the ultraviolet photon from the mercury atom, which was irrelevant to the answer.

QUESTION 02

02.1 A large majority of students achieved full marks in this calculation. The most frequent mistake was to quote the mass per unit length as the final answer. Others incorrectly used T (for tension) as a time period.

02.2 Just over half of the cohort correctly determined the new frequency.

QUESTION 03

Few students gave relevant reasons for the occurrence of characteristic X-ray lines. Students may be unfamiliar with the meaning of "characteristic" in this context. The most common relevant answers addressed the third and fourth marking points. Answers describing quantised energy levels in an atom were very rarely given.

QUESTION 04

04.1 Students generally coped well with processing the necessary information to get the total distance.

04.2 Most students gave the correct period in seconds. A common error was to give the value in milliseconds. This error was carried forward in 04.4.

04.3 This was the most challenging part of question 4 with just over one-third of the cohort deducing the displacement of the cone. Many failed to score by giving their value as "-1". This is insufficient precision given the scale of the displacement axis.

04.4 Almost all students correctly used their value of period from 04.2 to give a frequency.

QUESTION 05

05.1 Barely one-eighth of the cohort gave an adequate meaning for the term "resistance". A simple statement of "*potential difference divided by current*" was insufficient. Suggestions that resistance was the rate of change of pd to current were not accepted.

05.2 This question discriminated well. Many students knew that a non-ideal ammeter would have some resistance. References to the ammeter having "*internal resistance*" were condoned if they clearly referred to the ammeter alone. The second marking point was for a consequence of the ammeter's resistance, in terms of a decreased current in the circuit or a pd occurring across the ammeter. Only about 10% went further to give a precise reason why V_2 was smaller than V_1. Answers in terms of the formation of a potential-divider circuit often failed to reference the emf.

05.3 Very few students appreciated that the determination would still be valid as the readings on both meters would still be accurate for resistor **R**. This is a consequence of the voltmeter being ideal and the battery having no internal resistance. In this circumstance, the current in the ammeter is equal to the current in **R** and the pd across the voltmeter is equal to the pd across **R**.

QUESTION 06

06.1 There was an even distribution of marks across this question. A common mistake for the first marking point was a sketch with only a single peak. Students at AS level are not expected to know the detailed curved nature of the variation so any general shape with two peaks was permitted.

06.2 Students generally did this "show that" question well or not at all. Purely numerical answers were allowed here provided the examiner was clear where the values came from. For example, simply stating "0.90 s" was not a substitute for showing explicitly that it results from halving 1.80 s.

06.3 Most students did well with this calculation. However, as in previous series, many students failed to appreciate that the preceding "show that" value was relevant.

06.4 This question discriminated evenly. For full credit, students needed to appreciate that the total energy was constant but the period was smaller when moving from **O** to **R**.

QUESTION 07

07.1 Only about one-fifth of students gave a sufficient description of a longitudinal wave. Marking point two was commonly absent, with references to "*direction of wave travel*" given rather than in terms of a direction of energy transfer.

07.2 This question involved interpreting data from a graph with an ultrasound-reflection calculation. Some student misinterpreted the graph and took the width of a single peak as a relevant time. It is not. A determination of the reflection time is possible using peak **A** but a more accurate value is obtained using peak **D**. The final marking point rewarded students who took this latter approach.

07.3 This question was found to be very challenging for students. Few appreciated that the slower passage of ultrasound through the paint would give a larger reflection time. This would indicate a thicker block of copper, which is the cause of the inaccuracy. Some students appreciated that the paint would cause a change but gave a vague statement such as the "*time will be different*".

07.4 A surprisingly large number of students did not attempt or failed to score any marks in this question. As with all "show that" questions, the examiner must be able to follow the student's answer without having to infer steps in the solution. The best answers stated the path length for both **R** and **S** in terms of d and y, and then showed explicitly that the difference was $2y$.

QUESTION 08

08.1 Students accessed this "show that" question well. Many showed clearly that the equivalent resistance was $1.20\ \Omega$, even though the result for two identical resistors in parallel is commonly known.

08.2 This was another very accessible question. The most popular route involved calculating the current in the first step. A common mistake was to multiply the current by the internal resistance and state this value as the terminal pd.

08.3 This question involved interpreting the consequence of increasing the load resistance to the terminal pd. About 40% of students gained some credit. Of these, most stated that the total current would decrease due to an increased load or total resistance. Some went on to correctly state why this would increase the terminal pd. Very few students were successful in giving potential-divider arguments as they often failed to refer to emf, as was the case in 05.2.

08.4 This question was also found challenging by students. Many misread the question and compared the power transferred by **X** to that of **Y** and/or **Z**. Others simply stated that the power would be "*different*" without indicating whether it would be larger or smaller.

QUESTION 09

09.1 Most students gave the correct uncertainty. Common incorrect answers were 0.3 and 0.06.

09.2 Only about one-third of students could draw both best-fit lines. It was more common to see a good minimum gradient line. This passed through the first and final plots. Many students inaccurately drew the maximum gradient line also using the first and final plots. This line needed to pass through the bottom of the third plot.

09.3 There was an even spread of marks for this analysis question. Students who failed to score in 09.2 could still gain three marks. Although a solution involving the gradient was the most common route, a significant number of students tried to solve simultaneous equations. This was usually less successful.

09.4 This question was poorly answered. Those students who gained one mark were awarded it for stating that the maximum gradient needed to be determined. Few went on to give an accurate expression for an absolute uncertainty. A surprising omission by those addressing the third marking point was "*and multiply by 100*".

QUESTION 10

10.1 This question was poorly answered, mainly because most students did not state that the weight of m_A was relevant in compressing the spring. Others expressed an idea that the mass itself was a force, e.g. "*m_A is the only force on the spring*".

10.2 Students found this calculation accessible with about 50% gaining full marks. The common errors were: not using one-quarter of the mass, and failing to take into account the 30% compression. For this latter part, the attempt had to be correct; credit was not allowed for *any* use of 30%.

10.3 This was another accessible calculation with almost 70% gaining full credit. Quite a few students used a mass other than $30\ \mathrm{kg}$ in their calculation. They were awarded one mark when they subsequently determined the corresponding natural frequency.

10.4 Many students struggled to give a precise description of damping here. Some examples of this lack of precision are: "*reduce the amplitude of the car*"; "*dissipate energy to the surroundings*"; "*reduce the oscillation of the car*". A few additional words would make these statements accurate, but it is not for the examiner to fill in the blanks.

SECTION C

Questions 13, 15, 16, 21 and 23 were particularly well done in Section C, with at least 64% of students selecting the correct response.

Only question 17 (< 30% correct) was found to be particularly challenging. In this question, option A was the most popular response whereas the answer was D.

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