A LEVEL
PHYSICS

7408/3A
Report on the Examination

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General Introduction to the November Series

This has been an unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners will summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

Since the first series in 2017, students have found these papers increasingly accessible. The composition and demand of the 2020 questions were very similar to those in 2019 yet the outcomes were closer to those we saw in 2018 and 2017 when the papers were between 3 and 6 marks harder at each boundary.

Examiners saw less work of A-grade standard than we expect to see in a normal year. There were isolated examples of novel approaches but, in general, the work that stood out tended to be mathematically-based. An incidence in the number of part questions not attempted accelerated steeply toward the end of the paper, suggesting that time-management was an issue.

The lack of authority with which the students write about practical details of laboratory work is a recurring problem; many improvise responses that lack logic when asked to write about less familiar situations rather than the specifics of the required assessed practical activities. It is disappointing that we continue to see many students penalising themselves by providing poorly-presented graphical work. Others are unable to to communicate effectively using a sketch diagram.

Comments on Individual Questions

Question 1

This question expanded on the ideas behind assessed practical 7.

About half the students knew the mark should be at the equilibrium position in 01.1, but disappointingly few of them could explain why this was so.

In 01.2, some thought they were measuring the period and not the amplitude. Too many described trigonometric methods based on an angle measurement.

To determine the percentage increase in 01.3, some tried a mathematical approach based on the average rate of increase shown in Figure 3. We expected students to extrapolate the curve and those that did could usually proceed smoothly. Over half scored at least 2 out of 3 marks.

The key in 01.4 was to calculate the average having rejected the anomalous data, then determine the uncertainty from half the resulting range. About a third of the students were able to follow one or both of these steps.

It was hard to find many solutions to 01.5 and 01.6 that indicated work of A-grade standard and even the correct completion of Table 2 proved beyond nearly 10% of the cohort. Both in data tabulation and in the labels marked on graph axes, we expect consistency in decimal places. We saw far too many reversed scales that produced upwards-sloping lines and compressed scales that produced shallow lines. Less than 20% of students produced completely correct solutions to this routine problem.

01.7 discriminated well in favour of the stronger students who manipulated the equation to produce an expression of the form $y = mx + c$ and went on to deduce that $\delta = e^{-\text{gradient}}$. A novel approach seen was to deduce A_0 from the intercept and then obtain a value of A_n from a convenient point on the line, e.g. at $n = 2$. Going on to explain that $\delta = \sqrt{\frac{A_0}{A_n}}$ earned full credit.

Question 2
This question was about the bending of a beam and tested ideas about different types of error, orders of magnitude, and the interpretation of log-log graphs.

In 02.1 a popular distractor for the vernier reading was 45.8. Nearly 60% gave the correct answer of 37.8.

The word '*random*' was supplied by 40% to earn the mark in 02.2, although just as many preferred '*systematic*'. '*Human error*' is not a term examiners allow or expect students to use.

About 70% of students obtained a mark in 02.3 for stating that the thinner beam would deflect more. Some went on to identify correctly that this would reduce the percentage uncertainty in s. The third mark could be earned in a variety of ways, e.g. suggesting that the beam could become permanently deformed. We expected students to understand the distinction between elastic limit and limit of proportionality.

Many knew the meaning of the *Giga* prefix in the value of Young modulus in 02.4 and could then combine this with data obtained from Figure 8. A common error was failing to notice that s was in millimetres. Many students still do not understand what is required when we ask them to make an order-of-magnitude calculation (specification objective MS 1.4), the majority leaving their raw values for η on the answer line. Only 15% supplied the expected answer 8 or 10^8; we did not accept 1×10^8. A worrying number seemed confused by the unit on the answer line and spoiled a perfectly acceptable result by carrying out some additional mathematical operation.

Question 02.5 addressed specification objective MS 3.11 which identifies that logarithmic plots are used 'to test power-law variations'. This was the least accessible question on the paper, many claiming that Figure 9 showed an exponential relationship. This question exposed lack of knowledge in the same way as did the question about logarithmic scales from 2019. Successful students, of which there were less than 5%, suggested a mathematical expression such as $s = kL^n$, k being identified as a constant.

In 02.6, about 75% got as far as identifying log $L = -0.097$ but some failed to see the next step and used Figure 9 incorrectly.

Question 02.7 discriminated well in favour of the stronger students, but over 20% did not attempt this part.

Question 3
This question was about assessed practical 6.

Physics errors seen in the diagrams for 03.1 included some that were below the level of a good GCSE student. Some were drawn freehand or contained gaps. Only 40% obtained the mark for this part.

In 03.2, credit for describing the procedure was withheld when the voltmeter was connected across P or there was a suggestion that Q had been calibrated. Descriptions of the processing were generally consistent with the version in the physics handbook and about 30% were able to get full credit. However, it was disappointing that 25% scored zero and a further 11% did not attempt this very accessible question.

It was rare to find completely successful answers to the sequence from 03.3 to 03.5. In the first part we hoped to see ($22 \times$ the result of a gradient calculation) but full credit could be earned by outlining a simultaneous-equation approach. The only way to show that the current was about 0.25 A was by recognising that $n = 4$ and then using Figure 12. In 03.5, students could often deduce the e.m.f. and the internal resistance but less than 10% scored all 4 marks. The rubric states that answers to 1 sf will not (normally) be acceptable but it was common to find the internal resistance given as $0.9\ \Omega$.

In 03.6, it seemed that many did not recognise the impossibility of distributing data evenly across the gap between $n = 1$ and $n = 14$. Presumably this was why so many suggested the combination of $n = 4$, 7 and 10. Others suggested using non-integer values for n.

In 03.7, about 30% scored 1 mark, usually by deducing that the use of $27\ \Omega$ resistors would decrease the gradient. Only about 5% recognised that this would require both points to move to the right of the graph.

Concluding Remarks

Each marking point proved accessible except 02.5 and the third mark in 03.7. Despite having similar demands to the 2019 edition, the 2020 paper proved less discriminating, probably because stronger students were under-represented.

Students generally engaged with the command word although there is still a reluctance to ‘annotate’, e.g. where we ask them to put detail on a printed Figure. They did not always pay attention to the entirety of the command sentence, e.g. in 02.6 and 03.4 some clearly missed the instruction to use a particular Figure to make their deduction.

The mathematical skills employed by the students were usually sound and at least as good as in a typical series. Most recognise and can exploit the $y = mx + c$ idea. Working was usually transparent and faulty manipulation was rare.

There is evidence that teachers are not examining the ‘dark corners’ of Section 6 of the specification. Many students have a blind spot with log-log plots and with order of magnitude calculations.

Candidates are sometimes unsuccessful even with AO1 questions. Review of previous mark schemes would remedy many of these shortcomings.

Questions testing the AO2 criteria are also a mixed bag: in 01.4 the uncertainty calculations were often done well but the graph scaling/plotting in 01.6 was patchy.

When the information is out in the open and the context is familiar as in 03.5, students can make progress with AO3 questions, but the novel scenarios such as in 03.6 defeat most.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the [Results Statistics] page of the AQA Website.