AQA

A LEVEL
PHYSICS

7408/2
Report on the Examination

7408
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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

The cohort in November 2020 proved to be weaker overall than their predecessors in June 2019; this was not a surprise given the unusual nature of the examination. Work at the highest level was rarely seen. There was evidence of lack of preparation, with students answering in a careless way and at a trivial level. It was disappointing that some students were working at standards barely above GCSE. It was clear that many students had either not seen standard pieces of laboratory equipment or had not had the opportunity to work with them.

Comments on Individual Questions

Question 01.1
The graphical information appeared to be well understood by a vast majority of the students.

Question 01.2
Most students were aware of the changes taking place but many failed to gain marks when expressing the changes. It was common to see the statement, ‘*the structure changes from an ordered one to one where atoms are free to move*’. This could easily be a reference to a gas and so failed to gain the mark. Students also failed to gain the mark when their wording implied that all bonds between atoms are broken or intermolecular forces are made weaker. Less accomplished students described an increase in kinetic energy or presented only a macroscopic description.

Question 01.3
There was a very mixed bag of responses seen. The choice of rise or fall in kinetic energy or potential energy seemed to be random. Only a minority gave the correct answers. The ‘average’ student held to the incorrect idea that ‘*energy is being supplied so kinetic energy must increase’*.

Question 01.4
Only a tiny fraction of students made any reference to ‘*mean*’ or ‘*average*’. Also, when the answer involved ‘*speed*’ a number of students used the term ‘*velocity*’. At this level the correct technical language is essential.

Question 01.5
This question was answered well by students and many obtained full marks. The most common error was to equate heat energy to power. A host of other errors appeared in rather smaller

numbers; these included poor equation manipulation, not using the time data in minutes, or (surprisingly) mixing the symbols for time and change of temperature.

Question 01.6
Less than half the students could determine the specific heat capacity and identify the element. The most successful students were those who showed their working in full. The last mark in the question could be awarded even when an error was carried forward from a slip in the calculation. In practice this was rarely awarded, because these students did not show enough working to confirm whether the slip was in arithmetic or transposition rather than an error in physics.

Question 02.1
About half the students were given full marks, with a large portion of them showing the equations and an efficient manipulation of them. The remainder did not show such a logical approach. A typical technique was to write down as many equations as possible, placed in any position in the answer space. These students then hoped to find some link between them. The weaker students sometimes picked up the second mark for converting the equation for circular motion into one that involved time.

Question 02.2
A large number of students could not convert the equation into one showing proportionality and then substitute data correctly. Alternatively, they calculated *k* but then failed to rearrange the equation to make the radius the required subject. A few students failed to get started on the problem. However, a majority of the students found the question to be very straightforward and headed straight to the answer.

Question 02.3
Some students gained the three marks easily but a majority scored only one mark for rearranging the equation to make mass the subject. An equal number made no real attempt at answering the question.

Question 02.4
Students who initially established the escape-velocity equation either went on to gain full marks or dropped one mark for not noticing the difference between the radius and diameter. The main error by the less successful students was to equate a centripetal force with a gravitational force and obtain an expression for a velocity. They then thought (wrongly) that this velocity was the escape velocity.

Question 02.5
Half the students did calculate the gravitational field strength for Ariel but then had no real idea how to use this information. There were some students who gained full marks, but for many the sticking point was providing a proof that the object could not reach 100 m. Stating that the force was 39 times weaker does not constitute proof.

Question 03.1
About half of the students did not gain this mark. The main error was a failure to have the forces diametrically opposed to each other. The direction of the magnetic force was the one more likely to be given the wrong direction.

Question 03.2
A majority of students scored full marks on this straightforward question. However, some students struggled to find the correct equations to use and a smaller number simply made a power of ten error in their calculation.

Question 03.3
Most students answered this question successfully. The others typically failed to write down more than a single equation or they failed to make clear that the expressions they wrote related to a force.

Question 03.4
A large number of the students did not use the equation given earlier in the examination paper. Also, some did not appreciate that the ion was singly charged. A majority successfully calculated the radius but fewer students obtained full marks because it was common to double the radius in the final answer.

Question 03.5
An energy approach to answering the question was the most successful and about one-sixth of the students gained full marks. Many other students were partially successful but these did not appreciate that the potential difference change for the ion was only half of the 6000 V. Those answers gaining no marks normally showed an inappropriate equation.

Question 03.6
A number of students did not address the mass issue satisfactorily and focussed on the deduction of velocity. Simply stating $\text{velocity} = \frac{\text{distance}}{\text{time}}$ was not detailed enough when the ions are initially accelerated and then drift in a field-free region. Generally, students underperformed because they gave very general answers, such as '*the more massive ions take longer*'. Explanations were very thin on the ground. Also, technical language was poor. '*Bigger*' was used instead of '*larger mass*'. '*Gets quicker*' was used by students to mean both that the acceleration is larger and the time interval is smaller.

Question 04.1
A majority knew how to calculate the root-mean-square value.

Question 04.2
A lack of experience or knowledge of the oscilloscope was shown in this straightforward question, with only about half of the students obtaining the correct answer.

Question 04.3
A majority of students could not do this, including those with success in question 04.1. The most common error was to draw a horizontal line at the peak voltage.

Question 04.4
About half of the students obtained the correct answer. Many failed to choose the full period from the time scale. Some students simply quoted the time value as the frequency.

Question 04.5
The most common response to this question was a failure to determine the time constant. These scripts typically were not completely blank, but only showed a single equation copied from the data

and formulae booklet. Only a minority of scripts showed any attempt to extract data from the graph. Some students did find the correct answer, however, usually by using the time for the voltage to halve or to drop to 37% of an initial value. It was also evident that some students did not know that a time division is usually taken as the time interval between grid lines. Most thought a division was the gap between the fine grid marks. The overall impression left from this and other questions was that the 'average' student had received very limited exposure to an oscilloscope.

Question 04.6
The scripts showed an almost random distribution for whether the time-base should be increased or decreased. This also applied to scripts that suggested changing the *y*-gain. Even giving a control knob its correct name seemed problematic. Some students also suggested changing the nature of the input to make it easier to read or measure. When an appropriate change was suggested, very few students went on to explain the resulting change in the trace and how it reduces uncertainty.

Question 05.1
About one third of students answered with the correct '*electromagnetic force*' which is one of the fundamental forces. '*Electrostatic force*' was given by many other students. More surprisingly, and just as often, '*strong force*' was written.

Question 05.2
Very few students answered this correctly. Most scripts showed an arrow either in a vague upward direction (possibly normal to the path) or an arrow pointed tangentially along the path. It was clear that most students did not connect '*rate of change of momentum*' with a force.

Question 05.3
A very small number of the students who correctly chose alpha particle 5 or alpha particle 6 adequately explained their choice. Many described how the alpha particle hits the sphere of the nucleus and reflects off it. They seem to consider the diagram to be a scale drawing showing colliding balls. The answer alpha particle 4 was given frequently because it would get close enough to have a large scattering angle. Some students expressed the idea that 90° was the maximum possible scattering angle.

Question 05.4
Only a minority were fully successful in answering this question because few started with the correct equation that related the loss in kinetic energy to the gain in potential energy. Many confused an expression for force with one for potential energy. Many other students either made no attempt or presented one or two equations that bore no relation to the problem.

Question 05.5
Although more than one third of students performed well, a large number could not evaluate a computation that involved fractional indices. Some other students did not use the appropriate equation or thought that the radius was proportional to the nucleon number.

Question 05.6
Most answers were correct and normally focussed on suggesting that nucleons have similar mass or volume. There was a significant number of answers that did not focus on the question and gave statements that were almost self-evident, for example '*more nucleons give a larger radius*'.

Question 06.1
A majority of students thought that fission happens with both U-235 and U-238. Those who correctly identified U-235 as the fissile material often failed to mention U-238. The modal mark for this question was 1 and was normally awarded for a general description of fission using uranium, without identifying the isotope.

Question 06.2
Most students could rearrange the decay equation and obtain the correct answer. Some made the calculation much more difficult for themselves by converting to the number of nucleons, performing the calculation, and then converting back to mass. Only a small percentage of the students who used the half-life method managed to complete the full calculation. There were a number of weaker students who simply did not understand what was required and floundered from the start.

Question 06.3
A majority of students obtained this mark. Those who did not usually made no attempt to answer the question.

Concluding Remarks

Section B
The percentage scores in the multiple-choice questions were much higher than in the written questions.
A majority of the questions yielded success rates of between 50 and 75%. Questions B14 and B30 had higher success rates than this. Questions that scored in the region of 30 to 50% correct were B8, B16, B22, B26, B27, B29 and B31. Questions B7 and B24 were found to be particularly difficult with only about 16% of students being successful.

Mark Ranges and Award of Grades

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