GCSE
PHYSICS
8463/1H
Report on the Examination

8463
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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 November 2020 cohort was far smaller than the usual cohort; 437 in comparison to the 2019 entry of 105 000. The range of total scores was similar to previous series being from 5 to 87, which meant that the whole ability range was seen by examiners.

Grade 4-5 calculation questions ask for students to recall an equation first before using it in a subsequent calculation - these were generally well answered with at least 85% of students correctly recalling equations in these questions. The ability of students to then use the equation varied somewhat depending on whether a rearrangement or unit conversion was required. The grade 8-9 multi-step calculation Q9.1, was very well attempted with 53% of students scoring 5 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. Students who have handwriting that is difficult to read may benefit from a scribe or from word processing their answers in exams.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Question 1 (Standard demand)

01.1 This question was well answered, 65% of students scored 3 marks. Common mistakes included drawing a line through the circle of the ammeter or the voltmeter.

01.2 51% of students scored 2 marks. Students who chose to use a pen were at a disadvantage, as it made it difficult to determine which attempt to mark. Instructions on the front cover clearly direct students to use pencil for drawing (graphs, diagrams, etc.) Lines that became horizontal would score zero.

01.3 89% of students scored this mark. Most students recalled the equation in the V=IR arrangement. The equation can be recalled in any correct rearrangement, the quantities are listed in alphabetical order in the question.

01.4 A common mistake was to misread the current value as 0.8 A, rather than 0.08 A. Students who misread the graph but used the current correctly in the equation will have scored 3 marks. 59% of students scored 4 marks, while 27% of students scored 3 marks.

01.5 Only 35% of students answered this question correctly. Common incorrect answers included: the ammeter had no error, or the ammeter read zero all the time.

Question 2 (Standard demand)

02.1 69% of students chose the correct circuit.

02.2 86% of students answered this question correctly. The equation was acceptable using symbols or words. Students should be encouraged not to give multiple answers due to the list principle being applied: right + wrong = 0 marks. eg Q = It and I = t/Q would score zero.

02.3 The majority of students who knew the correct equation were able to substitute values of current and time into the equation and work it out. However, the value of current used was often incorrect, either because the student did not realise the need to convert 50 mA to amps, or the conversion was incorrect. Conversion values ranged from 0.00005 A to 50 000 000 A. 40% of students scored all 3 marks, while 43% scored 2 marks.

02.4 Very few students recognised that the LED is a diode and therefore only allows current in the forward direction. Students who did not refer to the diode mainly answered in one of two ways: thinking that no current can flow if the batteries are reversed in a circuit (no reference to the diode), or taking the question to mean that one of the cells was reversed, rather than all of them, and would therefore be 'working against each other'. Many students incorrectly thought that reversing the cells would make a gap in the circuit. Many students discussed polarity without mentioning the LED, so scored zero. Incorrect charge flow or incorrect current were not enough to score the first mark. Only 10% of students scored both marks, while 15% of students scored 1 mark.

02.5 Students should use the wording of the prompts in the question. For this equation there are no abbreviations for the words ‘useful’, ‘total’, ‘input’ and ‘output’. The ‘×100’ is not needed for the equation. 86% of students scored this mark.

02.6 88% of students scored 3 marks. However, a common mistake was to multiply the final answer by 100, so only the first two marking points would score.

Question 3 (Standard demand)

03.1 91% of students answered this question correctly. The equation was acceptable using symbols or words. Students should be encouraged not to give multiple answers due to the list principle being applied: right + wrong = 0 marks. eg ρ = m/V and m = ρ /V would score zero.

03.2 78% of students scored 4 marks. Most students who knew the equation were able to perform the calculation correctly. A significant number made transcription errors, eg putting the density as 988 kg / m^3 instead of 998 or adding / subtracting a 0 to the given volume. The majority of students were able to express their answer in standard form, even if their calculation was incorrect,.

03.3 85% of students answered this question correctly. The equation was acceptable using symbols or words. Students should be encouraged not to give multiple answers due to the list principle being applied: right + wrong = 0 marks. eg E = Pt and P = t/E would score zero.

03.4 59% of students scored 3 marks. Some students struggled to convert 5 hours into seconds, converting it into minutes instead. A correct calculation using minutes instead of seconds would score 2 marks.

03.5 Only 4% of students scored 2 marks, while 43% of students scored 1 mark. Many students failed to realise that they needed to take data from the graph and compare it with the stated output from the hydroelectric power station. Instead, they gave explanations in terms of people using more energy during the day and / or weather conditions affecting the supply of water. In many cases, despite the diagram showing the power station with a brief explanation of how it works, students referred to unreliable waves and wind, or varying tides. Of the students who took information from the graph, the most common answer was comparing the times involved. Although some students compared the peak demand with the power station output, not many referred to the increase in the demand, which was the relevant point.

Question 4 (Standard/High demand)

04.1 34% of students scored 2 marks on this question. Common incorrect answers were 68% and 312.5% both of which scored 0 marks. Calculation of percentage increase is a maths skill in the maths requirements of all GCSE Science qualifications.

04.2 Only 10% of students scored 2 marks, while 43% scored 1 mark. Many students incorrectly thought that gas was renewable and/or did not release carbon dioxide. Less air pollution or less toxic gases was insufficient to score a mark. Comparison of start up times was insufficient as it does not relate to environmental advantages. Other commonly seen incorrect ideas included the idea that a gas-fired power station uses gas from the air, which does not have to be extracted or mined as coal does, or gas-fired power stations not producing carbon dioxide. Stating facts about a coal-fired power station but not comparing it with a gas-fired power station was insufficient.

04.3 63% of students scored 2 marks, while 28% of students scored 1 mark. Students who scored 1 mark usually didn't refer to a time period on the graph, just indicating the general upward trend, ignoring the fact that between some time periods eg 1998 to 2008, the mean sea surface temperature actually decreased. An overview statement would have helped them score the second mark.

04.4 Only 5% of students scored 3 marks on this challenging question. Very few realised that the important factor was the change in resistance with temperature in the region of temperatures corresponding to the sea temperature values. The majority of students chose thermistor A 'because it has the lowest resistance'. 18% of students scored 1 mark and 73% of students scored no marks.

Question 5 (Standard/High demand)

05.1 40% of student scored a mark on this question. Electronics, microwaves, phones and food and drink were common incorrect responses. Man-made doesn't mean 'made by man' in this context it refers to the radiation source being artificial rather than naturally occurring. Incorrect answers commonly seen included things which are not man-made, eg sunlight, cosmic rays, other types of radiation which do not contribute to background radiation like microwaves or infrared.

05.2 74% of students could name a nuclear fuel. The most popular answer being 'uranium'. Commonly seen incorrect answers included coal, oil, gas and petrol.

05.3 Only 6% of students scored all 4 marks. To score the first marking point, students needed to indicate that the neutron becomes part of the U-235 nucleus, it was insufficient to only say that the neutron collides with the nucleus. Very few students scored the 4th marking point. Many students hadn't revised the process, evidenced by their meandering discussion of different radiation types and gold sheets. Whilst many students had some idea of the nuclear fission process, they often failed to gain marks because their answers lacked detail or were imprecise, eg neutrons being absorbed by 'atoms' rather than 'nuclei', a nucleus 'splitting' without the detail of two daughter nuclei being produced. A number of students went on to describe the chain reaction and / or the process of electricity generation which was unnecessary.

05.4 Only 8% of students scored both marks, with 29% of students scoring 1 mark. Elements fuse or atoms fuse was insufficient. Nuclei fuse was insufficient unless they said to form a larger / heavier nucleus. Very few knew that some of the mass of the nuclei was converted into energy. Some students fell back on their knowledge of chemical reactions and mentioned breaking bonds and exothermic reactions.

05.5 Only 8% of students scored 2 marks, 39% of students scored 1 mark. Very few students linked the short half-life to how the activity of the waste would change with time. Most students who scored the first marking point did so for saying the radioactive waste would decay quicker. Students tended to score the second marking point rather than the first, although vague statements like less harm/damage to the environment were insufficient.

Question 6 (Standard/High demand)

06.1 This question proved more challenging than expected with only 30% of students identifying two measurements and 51% of students identifying one.

06.2 73% of students scored all 4 marks for this question. A common mistake was not to convert the energy into J. This meant that the mass of the boy was much lower than the expected value (0.05 kg). Weaker students then rearranged the equation incorrectly to get a more believable answer, a common response was 20 kg ((17 x 9.8) / 8.33). Another common calculation error was to divide 8330 by 9.8 then multiply by 17.0 resulting in a mass of 1445 kg, which apparently didn't strike students as being a high value for the mass of a boy.

06.3 Very few students scored 3 or 4 marks for this question. Since the acceleration down the slide is unlikely to be uniform due to the changing gradient this question could not be answered by consideration of equations of uniform acceleration, therefore an approach using energy transfers was the only appropriate answer. A discussion involving terminal velocity didn't score as the slide height is not sufficiently high for terminal velocity to be reached. The first marking point was the most likely to be scored by students. 25% of students scored 1 mark, while 67% of students scored zero.

Question 7 (High demand)

07.1 31% of students answered this question correctly. ‘Takes time for electrical energy store to transfer to thermal energy store’ was a common answer but insufficient. ‘The charge flow takes time’ or ‘the current is slow to start with’ were also insufficient. ‘Water has a high specific heat capacity’ was also insufficient.

07.2 49% of students scored all 5 marks, while 22% of students scored 4 marks for this calculation. A common answer was 0.37 using the temperature change of 100 °C. This answer would score 4 marks for an incorrect temperature change. An answer given to 2 s.f. scored 1 mark as long as students had used the values in the question to calculate something. At grade 6-7, students are expected to be able to convert units and rearrange equations.

07.3 Very few students scored 2 or 3 marks on this question, 10% of students scored 1 mark. Weaker students misunderstood which straight section the question referred to thinking it was the horizontal section. Only the highest-scoring students understood that the rate of temperature increase (from the gradient of the diagonal line) could be used in conjunction with the equations for specific heat capacity and $E = Pt$ to calculate useful power output. A lot of students thought that the efficiency equation could be used, but usually failed to score any marks.

Question 8 (High demand)

08.1 91% of students correctly calculated the value in the table.

08.2 Only 4% of students scored 2 marks, while 24% of students scored 1 mark. Many students continue to think that precision is related to the resolution of an instrument and score zero. Statements like ‘it increases the accuracy not the precision’ were common and insufficient to score a mark. Some students thought that the 3 readings were related to the fact that there were 3 resistors, so the 4^{th} reading wasn’t needed as there were only 3 resistors. An answer of ‘the 4^{th} result increased the mean’ was insufficient as the mean would have always increased if the result had been greater than the mean.

08.3 Inverse proportion is a difficult concept for some students - many stated the general trend that as one quantity increases the other quantity decreases, scoring no marks. Only 2% of students examined the relationship in enough detail to score 3 marks. Very few students calculated the constant of proportionality.

08.4 This explanation was not well known, only 11% of students scored 2 marks, while 26% of students scored 1 mark. The most common answer was that ‘the resistance is shared’. Another common answer was to use the equation for resistors in parallel as an explanation. Of those students who had the correct idea, most gained a mark for stating that there would be multiple paths for the current to take, but very few were able to progress to the idea that the total current in the circuit would be greater.

Question 9 (High demand)

09.1 53% of students scored 5 marks on this multi-step calculation. Lower-scoring students didn't score marks for stating and trying to use incorrect physics equations or rearranging correct equations incorrectly. The main reasons for not scoring full marks included: knowing one form of an equation correctly, but re-arranging it incorrectly, eg stating P = I V then re-arranging it to I = V/P, mixing up two half-known equations eg $P = I^2 V$, not realising that the 5 marks for this question warranted more than using one basic equation, eg stating R = V/I and substituting the given value of power for I.

09.2 Students often didn't score the third mark because of their technical inaccuracies referring to potential difference of the live wire or the electrician instead of potential. Many students mixed up quantities like potential difference with current and charge in confused answers. The question discriminated well between students with 15% of students scoring 3 marks, 15% of students scoring 2 marks and 35% of students scoring 1 mark.

09.3 18% of students scored 2 marks, while 44% of students scored 1 mark. A good proportion of students appeared to understand what the graph was showing, but often had difficulty in expressing their ideas clearly. A number of students thought that a higher current would be a disadvantage, so stated either that the current was lower at frequencies other than 50Hz, or 're-wrote' the question to answer why 50Hz was the safest frequency. Simply reading off values from the graph was insufficient without an explanation of what the implications were.

Question 10 (High demand)

10.1 75% of students correctly identified two correct statements, while 23% of students identified one.

10.2 65% of students scored 4 marks. Students who understood that 'pressure × volume = a constant' were usually able to perform the calculation correctly. A few students made mistakes in copying down the quantities, eg missing off a 0 from, or adding an extra 0 to, the pressure. Many students who did not score marks thought that the relationship between the quantities was pressure/volume = a constant.

10.3 A good range of answers were seen and the question discriminated well between students. 1% of students scored all 4 marks, while 10% scored 3 marks, 25% scored 2 marks and 40% scored 1 mark. Most students realised that the answer involved the helium particles, and many referred correctly to the increase in kinetic energy or speed of these particles. However, few students were able to provide a coherent explanation beyond this. Whilst many referred to particle collisions, few indicated that the collisions were with the walls of the balloon and that the collisions would be more frequent. Many students seem to think that pressure is caused by particles colliding amongst themselves. A minority of answers went on to state that a greater force would be exerted on the balloon walls, but then failed to link this idea with the definition of pressure.

Mark Ranges and Award of Grades

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