GCSE
COMBINED SCIENCE: TRILOGY

8464/P/1H (Physics)
Report on the Examination

8464
November 2021

Version: 1.0

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General introduction to the November 2021 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

As this exam was taken in November 2021 rather than during Summer, the cohort of students who sat the exam is likely to have been very different from the usual cohort of students taking this qualification. There were also far fewer students in this cohort than usual. It may well be possible, therefore, that issues which arose on some questions and are written about in this report may not be typical of students in the normal course of events.

General comments.

There was a fair proportion of students who did not appear to take a calculator into the exam, and failed to gain marks because they incorrectly calculated their answers on paper. There were also a fair number of students who made mistakes when calculating, re-wrote their calculations, and failed to cross out their incorrect working. Students should be encouraged to both cross out working that they believe to be incorrect, and to take a calculator into the exam.

On this paper, students fared particularly poorly on questions set in a practical context, perhaps reflecting the difficulties of carrying out practical work during the Covid restrictions over the last two years.

Comments on Individual Questions

Question 01 (Standard demand)

01.1 Slightly over two thirds of students selected the correct equation.

01.2 Full marks were gained by over 60% of the students, with about 35% failing to gain any credit.

01.3 This equation was correctly recalled by around 70% of students.

01.4 Most students did not attempt to convert 2500 minutes into seconds. Nearly a quarter of students gained all 3 marks, with just over half of students gaining 2 marks.

01.5 Slightly less than 40% of higher tier students were able to correctly identify the symbol for a thermistor.

01.6 Most students failed to recognise that the resistance of the thermistor would decrease as temperature increased, with many students stating that because the potential different across the thermistor was constant, the current in the thermistor must also be constant. Another misconception demonstrated in a number of responses was that the current would increase because the increased temperature gives the current more energy. Roughly one in ten students gained 2 marks, with just over a third gaining 1 mark.

Question 02 (Standard demand)

02.1 This question was answered correctly by roughly 40% of students.

02.2 Around a third of students gained both marks, with approximately half gaining one mark.

02.3 Many students gave answers which were too vague, such as “beta radiation is not strong enough”, or stated that beta radiation is not ionising, which is incorrect. The mark was gained by just under a fifth of students.

02.4 Most students struggled to answer this question, with many struggling to write answers containing any relevant content. Many answers suggested placing the piece of paper or aluminium into the radioactive source holder, for example. A fair proportion of students did not read the question carefully, and suggested changing the radioactive source to test the equipment using one source of just alpha radiation, one of just beta, and one that emits just gamma radiation, although it was still possible to gain full credit if they did this. Some students recalled that paper stops alpha radiation, that aluminium stops beta radiation, and that gamma would penetrate both, but didn’t describe how to set up the equipment. Others described how to set up the equipment, but not how to use any measurements to draw conclusions.
Nearly one in ten students did not attempt to answer the question, and most answers did not give enough information to move out of level 1.

Question 03 (Standard/high demand)

03.1 Slightly over half of students answered correctly. The most common incorrect answer was to suggest that the boat could utilise tidal power.

03.2 It appeared that some students did not assimilate all of the information in the question, with answers stating that the boat can move using the generator. It was also fairly common for students to describe why using wind power is beneficial, but not to give reasons why it is useful to have both a wind turbine and a generator. Approximately 15% of students gained both marks, with nearly 60% gaining at least 1 mark.

03.3 This question proved to be accessible to all students, and differentiated well between them. Approximately a third of students gained both marks, a third gained one mark, and a third of students gained no marks.

03.4 Many students did not convert 81 kJ into J. Re-arranging the kinetic energy equation to give v also caused problems for a fair proportion of students. Roughly one in four students gained at least 3 marks. Over half the students gained no marks at all.

03.5 This calculation was carried out correctly by just over a third of students, with about 50% of students gaining no marks.

Question 04 (Standard/high demand)

04 This question was mainly set in the Required Practical Activity context of measuring density. The question as a whole was not well answered, and perhaps reflects the lack of practical experience for students during the pandemic lockdowns.

04.1 Many students did not name the type of error, but instead described the fact that the balance shouldn't read 4.2 g when there is nothing on top of it. Fewer than 1 in 5 students gained this mark.

04.2 Many students realised that they either needed to reset the balance before placing the cube on it, or subtract 4.2 g from each reading. A significant minority of students incorrectly suggested that a reading would only be correct if converted into kilograms.

04.3 The most common incorrect answer was for students to use the column headings in the table, and give the answer "length in mm". Identifying that the difference between the two readings was caused by differing resolutions of the equipment was successfully demonstrated by very few students.

04.4 The most common correct answer to this question was that the measuring cylinder should either be positioned vertically on placed on a level surface, with fewer students identifying that the reading should be taken from eye level. Roughly a fifth of students gained 2 marks, with around 50% gaining 1 mark.

04.5 While the mark scheme expected students to add coins to a partially filled measuring cylinder, a fair proportion of students used a displacement can and collected the overspill in a measuring cylinder. This approach could still gain full marks, but the idea of using multiple coins to find a large volume, and then dividing by the number of coins used, was rarely given in students answers. About 45% failed to score any marks on this question, and over a quarter of all students did not attempt to answer the question at all.

04.6 Some students attempted to find the cross sectional area of the disc used to make the old penny, but made mistakes in this part of the calculation. However, these students could still go on to gain up to 3 marks. Some students rounded their cross sectional area to 2.5 cm^2 and used this value to calculate a density of 8.5 g/cm^3 which gained them full marks. There was confusion amongst some students about 2 significant figures, with a small proportion of students instead giving their answer to 2 decimal places. Almost 1 in 10 students gained full marks, with nearly 20% gaining at least 3 marks. Many students, however, failed to make any headway with this high demand question, with around two thirds gaining no marks.

Question 5 (High demand)

05.1 Of those students who attempted to convert 240 mW to watts, there was confusion evident about whether mW referred to milliwatts or megawatts. Around 45% of students gained at least 3 marks.

05.2 Many students incorrectly suggested that the changing frequency of the potential difference explained the answer. Only around 15% of students answered correctly.

05.3 Almost 30% of students correctly identified the directly proportional relationship.

05.4 Very few students were able to correctly identify that the potential difference in both circuits would be the same. To gain full marks when discussing the ammeter readings, students had to realise that since the potential difference across each resistor is the same, and all resistors have the same resistance, the current in each resistor is the same. The current in the ammeter in circuit B is therefore double that of circuit A. The question was targeted at the highest ability students, and very few students were able to reason this through and state this relationship.

Question 6 (High demand)

06.1 The concept of internal energy is challenging to many students, and only around 15% of students gained any credit on this question.

06.2 Just over 10% of students answered this correctly.

06.3 This was correctly answered by just over a third of all students. Over half of all the students thought that the mass of the coolant decreases when it evaporates.

06.4 While many students realised that pressure was due to collisions between the particles and the pipe, it was uncommon for students to mention that the rate or frequency of those collisions would increase with temperature and density. Very few students recognised that with increased temperature each collision would exert a greater force on the pipe. Roughly 10% of students gained at least one mark on this question.

06.5 This question was targeted students working at grade 8-9. It required students to realise that the efficiency equation needed to be used before the equation for specific heat capacity could be applied. A fair proportion of students made errors in using the efficiency equation, ending up with an incorrect energy value. Of students who did this, the most common error was to calculate the useful energy, and then to subtract this from the total energy supplied, so that they ended up with 12.5% of 1560 kJ, rather than 87.5% of 1560 kJ. Although their incorrect use of the efficiency equation gained them no marks, these students were able to apply their calculated energy value to the specific heat capacity equation and still gain some credit on this question. Around 15% of students gained at least 4 marks.

06.6 Many students did not appear to have assimilated all of the information in the question, and used the information to incorrectly calculate that the efficiency of the heat pump was actually 25%, rather than the 400% advertised. A few students referred to the previous question and stated that the efficiency of the heat pump is 87.5%, which gained no credit. It was uncommon for students to realise that the energy transferred to the coolant comprised of energy transferred from the air outside the building in addition to the energy transferred from the mains electricity supply. The most common mark scored in this question was by those students who recognised that efficiency cannot exceed 100%. Nearly a fifth of all students made no attempt to answer the question.

Mark Ranges and Award of Grades

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