GCSE
COMBINED SCIENCE: TRILOGY

8464/P/1H: Paper 1 Physics Higher
Report on the Examination

8464
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General

Overall, the vast majority of students were able to make an attempt at every question on the paper, with almost all students showing some attempt at even the most demanding question parts. This was the second series of the examinations for the new science GCSEs and there are some sections of the specification which appear to be less familiar to students, in particular some aspects of working scientifically and some of the mathematical requirements.

Levels of demand

Questions were set at three levels of demand on this paper:

- **standard demand** questions were targeted at students working at grades 4-5
- **standard/high demand** questions were targeted at students working at grades 6-7
- **high demand** questions were targeted at students working at 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 The majority of students correctly identified that the ammeter needed to be connected in series with the resistor and the voltmeter in parallel with the resistor. Some students who used a computer to type their answer did not gain the mark because they typed answers such as 'the ammeter is in series and the voltmeter in parallel' which could have meant either the third or fourth options in the table.

01.2 Most students correctly identified that the current decreased when the resistance of the variable resistor increased. Current slowing down was not an acceptable alternative but a reduced rate of flow of charge was accepted.

01.3 About a fifth of students were able to answer this question correctly. Common incorrect answers included students swapping the positions of the meters, adjusting the variable resistor, or adding more resistors. Others suggested using a 'negative battery'. A small proportion of students stated that the direction of the current needed to be reversed but did not describe how the circuit should have been changed to achieve this.

01.4 Just under half of students were able to recall that current is directly proportional to potential difference.

01.5 Slightly more than three quarters of students correctly recalled this equation. Many students used lower case letters i, v and r to represent current, potential difference and resistance, which was allowed. Also acceptable was a correct combination of symbols and words, such as V = current × R, for example.

01.6 Nearly three quarters of students gained 3 marks on this question, with about one quarter of students gaining no marks, and only a small fraction gaining 1 or 2 marks.

Question 2 (Standard demand)

02.1 Around 30% of students gained 3 marks on this question, with just under a third of students gaining 2 marks and approximately a fifth of students gaining just 1 mark. Many students wrote about successful collisions, which was condoned here. However, writing about particles moving less was not seen as equivalent to writing about particles moving more slowly. The most common reason for gaining 2 marks, rather than three, was the omission of any mention of collisions.

One common misconception observed was that, as the particles cool down, the number of particles increases. There were also a number of students who did not mention pressure in their answer, instead discussing how the movement of particles changed as they cooled and how this linked with temperature.

02.2 Just over half of the students gained full marks on this question, with a little under 15% gaining 2 marks. Those students who scored 2 marks had usually made an erroneous conversion of either kJ to J or kg to g. Many students tried to answer the question using the equation $E = mc\Delta\theta$, using 20 °C as their change in temperature, and gaining 0 marks.

02.3 Slightly less than a third of students gained 2 marks on this question, with around 20% of students gaining 1 mark for correctly identifying two states. A small but significant number of students chose to fill the boxes with numbers representing temperatures, rather than ticking one box for each row of the table.

02.4 This 6-mark question enabled almost all students to write something relevant, and as a consequence only a very low proportion of students failed to score any marks. Around 60% of students gained marks in level 2 of the mark scheme for describing changes to arrangement and/or motion of the particles, but not giving any explanation for these in terms of either the energy of the particles or the forces between them. Students who drew diagrams to aid their descriptions and explanations tended to score well on the question. Many of the students who gained 0 marks on this question failed to talk about particles, instead naming and describing changes of state.

Question 3 (Standard/high demand)

03.1 Just over 70% of students described a non-renewable resource correctly, as either a resource which is not replenished as it is used, or as a resource which is finite and will run out.

03.2 Slightly more than 40% of students gained full marks on this question. Around one in seven students gained 3 marks, mostly for failing to convert 6.9 kW into watts, or for making an incorrect conversion. Around 35% of students gained no marks on this question.

03.3 About a third of students gained 2 marks on this question but over half the students gained 0 marks. Answers describing current or potential difference were accepted, but a proportion of students incorrectly described direct current as what happens in a series circuit, and alternating as what happens in a parallel circuit. Other misconceptions included students who suggested that direct potential difference takes a constant value but alternating potential difference changes value. While this may be true, it does not explain the difference between direct and alternating.

03.4 Just under half of students scored 1 mark, with around a further 15% of students gaining both marks. Many students gave answers in terms of the risk of electrocution or safety, which did not gain credit. Many students wrote of more electricity going through a lower resistance cable, which was not sufficient: they needed to either mention a lower potential difference across the cable, or a greater current in the cable for the same potential difference.

Question 4 (Standard / high demand)

04.1 Around 15% of students correctly identified the total resistance.

04.2 Fewer than 5% of students gained both marks on this question, although just under a third of students scored 1 mark. The concept of parts of a circuit being in series and other parts being in parallel seemed to cause problems. Many students seemed to know that resistors in series are added together, but then proceeded to add 10 plus 10 plus 10, demonstrating that they had not appreciated that the two resistors are in parallel. Many students ignored the resistance of the lamp because it was not a resistor. Another common misconception was that resistance is shared, and to discuss resistance as if it behaves like potential difference.

04.3 Around two fifths of students could draw the correct circuit symbol for a thermistor. Many students drew the correct symbol but then added an arrow to the line through the resistor, which meant they did not gain the mark.

04.4 Slightly less than 60% of students gained at least one mark, with just less than 15% of students scoring both. It was not uncommon for students to erroneously suggest that current increases because it gains more energy from the increase in temperature.

04.5 Very few students recognised that the potential difference across the resistor would drop to zero and across the lamp the potential difference would be the same as the battery. Around 45% of students gained at least 1 mark, usually for mentioning that the potential difference across the lamp would increase. Many students stated that the switch controlled the entire circuit, turning it on or off. Many students appeared to be confused by the difference between current, potential difference and resistance, and many did not write about potential difference (or voltage) at all in their answers.

Question 5 (High demand)

05.1 Just over 40% of students scored at least 1 mark on this question and just below 5% of students gained both marks. Of those gaining no marks, some stated that the hot water in the kettle increased the temperature of the heating element. Many students wrote about friction in the circuit causing heating, although some of these answers gained one mark by also mentioning that a current was involved.

05.2 Slightly more than 15% of students identified that the starting temperature of the kettle, water, or heating element needed to be controlled. A small proportion of students suggested that the kettle itself was a control variable, but this was not allowed as if this had been changed, the investigation would not then have been about a particular electric kettle.

05.3 Around 1 in 10 students gained this mark for either suggesting that the kettle or element took time to heat up, or for suggesting that the kettle took time to detect that there was no water in the kettle. The data for this question was taken from a real kettle. Many students stated that the kettle took time to switch off when it was empty, which is effectively saying the same as the line does not go through the origin, so and gained no credit. A large number of students stated that it is not possible to put no water in a kettle, and again this scored no marks.

05.4 Only a very small proportion of students gained this mark. Most students did not appear to realise that they had to suggest what caused the curve to be non-linear, and instead described what was meant by a non-linear trend or pointed out that the graph was not directly proportional.

05.5 Just over 60% of students scored 0 marks on this level 8-9 calculation question. However, the students who did manage to access the question generally scored rather well, with more than 25% of all students gaining 5 or 6 marks.

Question 6 (High demand)

06.1 Just under half of students gained this mark.

06.2 Slightly less than 30% of students gained this mark for identifying that gamma radiation is weakly ionising or very penetrating.

06.3 Around 10% of students gained marks on this question. There was a very common apparent misunderstanding about what is meant by the term count-rate, with many students stating that the count-rate is the total number of decays that have happened since the radioactive source was created. It was also quite common to see answers about the random nature of decay making the count-rate unpredictable.

06.4 While about a quarter of all students gained at least 1 mark on this question, very few gained both marks. The most common reason for gaining a mark was mentioning a cancer risk. Many students stated that standing away from the source would prevent irradiation completely, rather than reducing the level of irradiation and therefore reducing the risk. A common misconception was that if the teacher stood closer to the experiment then this would affect the results.

06.5 The concept of inverse proportion was not understood well. Many students incorrectly described inverse proportion as being a straight line with a negative gradient and illustrating that this was not the trend shown by pointing out that the count-rate decreased by different amounts each time an extra half centimetre of lead was introduced. Around 13% of students gained marks for their response to this question.

06.6 Around 40% of students could recall the atomic and mass numbers which go with an electron, and around a quarter of all students gained both marks on this question.

06.7 This question was aimed at the highest-attaining students, and required a high level of logical thought to arrive at the correct answer. Over a fifth of students managed to gain at least 1 mark, with just under 6% of students scoring all four marks.

06.8 This question was also aimed at the highest-attaining students and tested some of the maths content of the new science specifications at GCSE. Just under 6% of students attempted to draw a tangent on the graph, and therefore gained some credit. Many of those who attempted to calculate the gradient of the tangent divided the change in x by the change in y, giving an incorrect answer.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

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