



GCSE

Combined Science: Synergy

8465/4H Paper 4 Physical Sciences Higher Tier

Report on the Examination

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General comments

There were 9 questions on this paper. Questions 1, 3, 4, 6, 7 and 9 were physics while the others were chemistry. The questions are designed to increase from standard demand to high demand through the paper.

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.

Questions 1, 2 and 3 are common with questions 8, 9 and 10 on the Foundation tier. These questions are identical with each other and are targeted at standard demand.

Question 1 (standard demand)

- 01.1** A variety of answers to identify the shape of the magnetic field was seen including rectangular coil and iron rod. The majority of answers mentioned 'magnet', mostly unqualified, some described as 'permanent'. Both of these responses were insufficient, as there are various shapes of permanent magnets. The correct answer of 'bar magnet' was given by fewer than 15% of students.
- 01.2** Most students did not explain that the iron rods would become magnetised. Around two-fifths of students were able to gain a mark for saying that the two rods had the same magnetic poles next to each other, causing them to repel. Often, the rods were described as being 'charged'.
- 01.3** Around 50% of answers were correct in referring to copper as not being a magnetic material. Incorrect answers referred to the reactivity of copper or its electrical conductivity.
- 01.4** Most students realised that poles would be 'north' and 'south'. More than half identified them the correct way round, others had them reversed. A significant number of students labelled the poles as 'positive' and 'negative'.
- 01.5** The vast majority chose the correct reason for the newtonmeter reading.
- 01.6** Most students realised that the electromagnet would attract the iron disc. Not many referred to the increased current causing an increase in the strength of the magnetic field. However around three-quarters correctly stated that the force would increase as the current increased.
- 01.7** More than half of students drew a similarly shaped curve above the given line and the majority of these started at 2.0 N when the current was zero.

Question 2 (standard demand)

- 02.1** Most students seemed to have a good understanding of the variables which needed to be controlled in this experiment. The most common error was writing ‘amount’ instead of ‘volume’ or ‘mass’.
- 02.2** The vast majority identified the order of reactivity correctly.
- 02.3** A few answers gave tests for oxygen or carbon dioxide. Whilst many realised that the test for hydrogen was the ‘squeaky pop’ test, around half said that a lit splint would have to be applied to the gas to produce the squeaky pop.
- 02.4** Around 30% of students did not attempt this question, either because they did not realise it was a question or because they were unfamiliar with the apparatus. Of those who addressed the question, some added additional labels and/or equipment such as a thermometer. Those who attempted to draw something resembling a delivery tube coming from the conical flask often positioned it incorrectly, eg to the upturned base of the measuring cylinder rather than inside the open end under the water.
- 02.5** Whilst a number of students had some idea of what to measure, they often failed to score because of imprecise language, eg ‘amount of gas’, ‘the mark on the measuring cylinder’, ‘time’.
- 02.6** Around one-third gave the correct unit. Common incorrect responses were cm^3 , seconds, g/cm^3 . Some answers did not appear to be related to the experiment at all, eg Newtons, miles per hour.

Question 3 (standard demand)

- 03.1** Around three-fifths of students chose the correct symbol for the thermistor. The LDR was the most popular incorrect choice.
- 03.2** Around one-fifth of students identified that $20\text{ }^{\circ}\text{C}$ was room temperature. The most common incorrect answer was that the resistance would be too high to measure.
- 03.3** More than 5% of students did not attempt this question. Of those who did, many described measuring the current in, and the potential difference across the thermistor and using the equation $R = V / I$ to calculate resistance. A large number of these neglected the aim of the experiment, which was to investigate the resistance of the thermistor at different temperatures. If the answer made no reference to changing the temperature, it was limited to a Level 1 mark. Some students attempted to describe other experiments such as how the resistance of a wire varies with length, or the potential difference-current characteristics for a filament lamp.
- 03.4** Most students gave the correct equation with a few rearranging the equation given on the equation sheet incorrectly.
- 03.5** Around 60% of students did this calculation of current correctly to score 4 marks. A few rearranged the equation incorrectly but were able to gain 2 marks if they had shown the correct resistance and substituted into $V = I R$ before rearranging. Some scored no marks because they substituted the value of temperature instead of resistance.

Question 4 (standard/high demand)

- 04.1** The majority of students scored both marks for this calculation of speed. The most common error was misreading the graph. A few students multiplied distance and time instead of dividing.
- 04.2** Around one-quarter of students realised that the skydiver accelerated initially then reached terminal velocity. The question asked for a description of how the ‘motion’ changed. Students are expected to use appropriate vocabulary such as ‘speed’ or ‘velocity’ and ‘acceleration’. A common error was saying that the ‘motion increased’ or the ‘motion remained constant’ – this was insufficient. Similarly, students are expected to describe ‘change’ in terms of increase, decrease or remain constant. A number of students failed to score marks because of insufficient answers, such as ‘the speed changes’.
- 04.3** Very few students were able to give a coherent account of how the resultant force changed. In order to describe the resultant force, the individual forces acting on the skydiver, ie weight and air resistance, need to be discussed. Many students did not name these forces. Some students, who realised that the skydiver was finally travelling at terminal velocity, thought that there must be a resultant force acting to cause the continued motion. At no point in the question up to this point had there been a mention of the parachute opening; the graph clearly showed that this had not happened. (question 04.4 subsequently referred to the parachute being opened). Nevertheless, a significant number of students attempted to explain what would happen to the resultant force at this stage.
- 04.4** The correct graph was chosen by around half of students. The other two graphs which showed curved lines were evenly split amongst most of the remaining students, with just a very small number choosing the straight-line graph.

Question 5 (standard, standard/high & high demand)

- 05.1** Whilst many students realised that in the molten state ‘particles’ are free to move, few referred to these particles as ‘ions’. This resulted in around 15% of students gaining the mark.
- 05.2** Despite the word ‘inert’ being emboldened, many students chose to answer the question ‘why are electrodes used?’ Around one-fifth of students answered correctly.
- 05.3** Around 10% of students did not attempt an answer. The majority of those who answered either did not know that the gas produced was chlorine, or did not know how to test for it. Tests for carbon dioxide, hydrogen, oxygen, and combinations of these tests were seen. Of those who knew the test for chlorine, very few referred to the litmus paper being damp.
- 05.4** Around 10% of students did not attempt an answer. Of those who gave an answer, it appeared that many did not know what a half equation was. Around one-fifth of students gained the mark.
- 05.5** Around one-quarter of students gave the correct answer of ‘reduction’. Common incorrect responses were ‘oxidation’ and ‘exothermic’.

- 05.6** Very few students scored more than 1 mark; this was usually for stating that hydrogen is less reactive than potassium. Some answers indicated a basic understanding but failed to use correct terminology – for instance ‘ions’ were rarely referred to.
- 05.7** Around one-fifth of students gained all four marks, usually setting out their working clearly. Some gained three marks for following the correct method but failing to convert the volume to dm^3 , or converting it incorrectly. Some students gained one mark for working out the mass of potassium chloride.

Question 6 (standard/high & high demand)

- 06.1** A large number of students correctly converted the power from kW to W then calculate the current correctly. This resulted in around two-thirds of students gaining all four marks. Those who failed to convert, or converted incorrectly, were still able to score three marks for a correctly followed through calculation.
- 06.2** Around one-quarter of students gained all six marks for calculating the charge flow, usually showing the steps in their calculation clearly. A further three-fifths scored five marks for performing the logical steps but failing to convert the time of 6 hours into seconds.

Question 7 (standard & standard/high demand)

- 07.1** Around two-thirds of students gave the correct direction for the force of the wind. The clearest unambiguous answers said, ‘from the left to the right’ and in some cases also showed an arrow pointing to the right. Some answers were inconsistent, for example saying ‘left’ but showing an arrow pointing to the right.
- 07.2** A quarter of students gave the correct answer of ‘upthrust’. A variety of other forces were given, including gravity. Also seen were names of different energy stores such as thermal, kinetic and gravitational potential.
- 07.3** Around two-thirds of students correctly converted the weight from kN to N. Most of these then calculated the mass correctly, to gain all four marks. Those who failed to convert, or converted incorrectly, were still able to score three marks for a correctly followed through calculation.
- 07.4** Whilst some answers indicated that students probably had an idea of what was meant by ‘resultant force’, around one-tenth were able to state this coherently.
- 07.5** Around 10% of students did not attempt an answer. Those students who understood the concept of components were generally able to score all three marks, about one-third of students. A few mixed up horizontal and vertical but were still able to gain two marks. A few correctly stated the lengths of the horizontal and vertical lines on the diagram, but used the wrong scale factor, so did not score the final mark.

Question 8 (standard, standard/high & high demand)

- 08.1** Very few students knew the definitions of ‘strong’ and ‘dilute’ acids. More than 90% either failed to answer or did not gain a mark. Referring to ‘dilute’, a few responses mentioned adding water to the acid. However, there was hardly any reference to ions.
- 08.2** Responses were fairly evenly split between the correct ‘decreases by a factor of 10’ and the incorrect ‘increases by a factor of 10’.
- 08.3** Very few students scored more than three marks for this five-mark question. Around 60% either did not answer or scored no marks. Many students did not realise that the residue left on the filter paper was the excess calcium carbonate, instead describing a method of crystallising the filtered solution and thinking that the crystals formed were calcium carbonate. Some students had the correct idea but failed to score because of imprecise wording, eg ‘find the amount of ...’, ‘measure how much ...’, etc. Very few discussed drying the residue and even fewer mentioned washing it.
- 08.4** Around two-thirds of students chose the correct expression. The most common incorrect response was the first option.
- 08.5** The most common response was the incorrect formula CaNO_3 . Around one third of students selected the correct formula, with the incorrect Ca_2NO_3 being almost as popular a choice.
- 08.6** More than 10% of students did not attempt an answer. The 15% who understood the principle were usually able to gain all six marks. Some worked out the number of moles incorrectly but then worked through the rest of the calculation, so were able to score four marks. Some students calculated the relative formula mass correctly but then did not know how to proceed.

Question 9 (standard/high & high demand)

- 09.1** Very few students realised that the voltmeter was reading the potential difference across the battery, so would remain constant at 12 V. Whilst a fair number of students were able to identify that the ammeter reading would decrease, very few were able to give a coherent reason relating to the increase in the total resistance of the circuit.
- 09.2** Around 14% of students did not attempt an answer. A further 80% gained no marks. Some students scored one mark, usually for stating that the sum of the potential differences across the two resistors was always equal to the 12 V potential difference across the battery. The few who gained more than one mark explained the potential difference across the fixed resistor when the variable resistor had its two extremes of resistance. A common misconception was that when the voltmeter was in parallel across the fixed resistor, the voltmeter would ‘take’ half of the volts, leaving the other half for the fixed resistor.
- 09.3** Around 12% of students did not attempt an answer. Very few students were able to give a correct way of reducing the potential difference across the fixed resistor. Whilst several answers indicated that another resistor could be added, very few specified that it needed to be in series with the existing resistor. The most common correct answer, given by around one-tenth of students, was to decrease the potential difference across the power supply or to remove one of the cells from the battery.

Mark Ranges and Award of Grades

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