



GCSE

Combined Science: Synergy

8465/3F Paper 3 Physical Sciences Foundation Tier

Report on the Examination

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General comments

There were 10 questions on this paper. Questions 3, 5, 7 and 9 were physics content, Question 8 biology content, and the others were chemistry. The questions are designed to increase from low demand to standard demand through the paper.

This paper also contained items targeting mathematical and practical skills. Students should be advised to clearly show the method of their working when completing calculations, even simple ones that are easily done on a calculator. It can be difficult for examiners to credit responses if they cannot clearly follow the method the student has used. Some students made good use of the Physics Equations sheet with this paper. Many students seemed unfamiliar with laboratory techniques, equipment and methods. Three Required Practical Activities were targeted in this paper, RPA15, RPA20 and RPA18.

Levels of demand

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

- **Low demand** questions are designed to broadly target grades 1–3.
- **Standard demand** questions are designed to broadly target grades 4–5.

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

Question 1 (low demand)

- 01.1** Three quarters of students correctly identified 'atomic number' as the order in which the elements are arranged in the periodic table.
- 01.2** In this multiple-choice question, just over a third of students identified the correct configuration for neon. The distractor with the electronic structure of 2,2 was chosen almost as often.
- 01.3** About three fifths of students were able to identify a property of Group 0 elements with 'consists of molecules' being the most commonly selected distractor.
- 01.4** The scientific term 'state' was not well understood. Two fifths of students said 'gas' and incorrect responses included:
- numbers from the table
 - names of Group 0 elements
 - heat
 - stable
 - unreactive
 - solid/liquid.

- 01.5** Two fifths of students identified the trend with ‘decrease’ being a common incorrect response.
- 01.6** Over four fifths of students identified $-186\text{ }^{\circ}\text{C}$ as the boiling point of Z.
- 01.7** About three quarters of students were able to use the periodic table to identify element Z as argon. Some gave the element’s symbol Ar.

Common incorrect responses were:

- zirconium
- zinc
- calcium.

Question 2 (low & standard demand)

- 02.1** Nearly three fifths of students gained both marks by naming the two elements in a hydrocarbon. Incorrect responses included ‘water’ and ‘carbon dioxide.’
- 02.2** Just under half of students gained two marks. Methane was the best-known hydrocarbon and graphite was the most common incorrect response.
- 02.3** About half of students were not able to complete the formula of ethene with a variety of numbers of atoms seen.
- 02.4** Two fifths of students identified ‘cracking’ as the process.
- 02.5** Roughly a tenth of students scored both marks, with three fifths scoring one mark for identifying C_6H_{14} as having the higher boiling point.

A common incorrect response for the reason was that hexane ‘contains more molecules/electrons’ or that ‘the numbers were higher.’ Some responses referring to ‘atoms’ were accepted if it clearly implied the size of the molecule.

- 02.6** A quarter of students were able to identify carbon dioxide as the other product of complete combustion. Some common incorrect responses were:
- oxygen
 - gas
 - carbon monoxide
 - an incorrectly written formula for carbon dioxide such as CO_2 .
- 02.7** About a quarter of students did not attempt this calculation of the relative formula mass of water. A similar number scored both marks.

Question 3 (low & standard demand)

03.1 Just under a half of students chose the correct answer and ‘the deceleration is greater’ was ticked almost as often.

03.2 Nearly three fifths of students chose the correct response.

03.3 Incorrect answers were usually $0.5 \times 60 \times 3.0 = 90$ so not squaring the 3.0. However, about three quarters successfully used the equation and values to score 2 marks.

03.4 About three fifths of students scored both marks. Some scored 1 mark for an answer of 1.59. This came from a correct substitution but calculation of the square root of 2 instead of the whole equation. Another common response was 2.25 where the square root sign was not included, therefore receiving 0 marks.

03.5 Comprehension of these energy stores, and the transfer, was generally weak with a tenth scoring both marks. Over half of those who attempted the item scored nothing.

Several students stated that the speed of the sphere would increase without relating it to E_p and/or E_k . Quite a few said both E_p and E_k increased so scored marking point 2.

03.6 About a third scored 2 marks whilst a third scored 1 mark. There were several references to energy or gravity – maybe influenced by the previous item.

Non-creditworthy responses included ‘obstacles’ and ‘bouncing’. Many focussed on the sphere at the bottom of the hill (the ground becoming flat, slowing down, less/no gravity) rather than on factors that affected the sphere whilst rolling down the hill.

Question 4 (low & standard demand)

04.1 A fifth of students did not gain a mark in their response. Roughly four fifths were split equally between 1 mark or both marks. The item differentiated well for students and very few did not attempt the question.

04.2 Three quarters of students gained both marks for correctly linking the boxes using data from the bar chart.

04.3 At this level, the calculation had scaffolding to better support students with each required step.

A fifth of students gained full marks. Another fifth gained 1 mark, predominantly for correctly reading the value for the environmental impact of 2.2 arbitrary units from the bar chart. A third gained no credit, and a fifth did not attempt the question.

Many students gave the total environmental impact of 4.0 arbitrary units as the value for the environmental impact caused by energy use for shirt **A**. Some students multiplied the environmental impact caused by energy use for shirt **A** by the total environmental impact to give the required percentage giving a value of 8.8% or 88%.

04.4 About a quarter of students scored this mark. Common insufficient responses were:

- reliable
- fair
- accurate
- true
- assuming independent meant ‘on their own’.

Question 5 (low & standard demand)

05.1 Just under half of students scored both marks. The most common way to score 1 mark was ‘wind’ with ‘nuclear’ as the incorrect distractor.

05.2 A fifth of students scored both marks. The most common way to score 1 mark was ‘some birds are killed by wind turbines’ with ‘wind is an unreliable energy resource’ as the incorrect distractor.

05.3 Over four fifths of students gained both marks for the calculation of total power input given the equation.

05.4 Well over four fifths of students chose the correct equation, which was on the given Physics Equations Sheet.

05.5 Just under three quarters scored all 3 marks for calculating current. Those that scored 0 marks usually multiplied $144\,000 \times 960$ or reversed the division.

05.6 Just under half of students chose the correct response with almost as many choosing ‘the energy loss increases.’

05.7 About two fifths of students chose the correct box with the other distractors fairly evenly chosen.

Question 6 (low & standard demand)

06.1 Less than two fifths of students identified the bonding in magnesium as ‘metallic’. The incorrect distractors ‘covalent’ and ‘ionic’ were selected in roughly equal proportions.

06.2 Just over half of students identified the bonding in oxygen as ‘covalent.’ The least common distractor was ‘metallic.’

06.3 This description of ion formation was not attempted by nearly a quarter of students and a third of those who did were not awarded a mark. Of those that scored marks, 3 marks was the most common score. This was usually for the first three marking points, recognising that two electrons are transferred from a magnesium atom to an oxygen atom.

References to sharing of electrons meant these mark points could not be awarded. Incorrect terminology of atoms and ions was also seen despite the labelled diagram. Several students talked about ions transferring electrons.

- 06.4** Many students identified that lithium was reactive, but very few said that lithium would react with water, oxygen or air. A lot of students said that lithium did not react with oil which was insufficient. About a quarter of students gained this mark.
- 06.5** Just under two fifths of students gained a mark for describing the relationship between the data in the table. Insufficient responses were that the mass of lithium oxide was always bigger, the mass doubled, or it increases. The terms in the stem of the question were not often used.
- 06.6** Nearly two fifths of students gained full marks for this line graph. Another third gained 3 marks, mainly for omitting to label the x-axis correctly, or sometimes due to a plot being out of tolerance. Some students did not draw a straight line of best fit with a ruler. A few students attempted to draw a bar chart.
- 06.7** Nearly two thirds of students correctly calculated this mean. Students should be encouraged to display their method. This is so a method mark can be awarded if an arithmetic error is made.

Question 7 (low & standard demand)

- 07.1** Over four fifths of students identified the component as a variable resistor given ‘a battery’ and ‘an open switch’ as the distractors.
- 07.2** Nearly two fifths of students did not attempt this extended response question and another two fifths scored 0 marks. About a quarter scored any marks and were almost all Level 1 responses. Knowledge of circuits for this Required Practical Activity was very weak.

Common errors were:

- incorrectly identifying which instrument to use to measure I or V
- measuring the time taken for something to happen in the circuit
- just repeating the wording in the stem
- saying to use $V = IR$ with no context
- referring to energy in the circuit.

- 07.3** Four fifths of students correctly read the scale as 1.2 A. Incorrect responses were mainly 1.1 A.
- 07.4** Students seemed unfamiliar with these graphs and less than a third scored more than 1 mark.

Question 8 (standard demand)

- 08.1** Less than a tenth of students identified the type of molecule as a ‘protein.’ Common incorrect responses were:
- amylase
 - solid
 - large molecule
 - atom
 - catalyst.
- 08.2** A quarter of students knew that the mass of a catalyst stays the same during a reaction. Most students chose ‘the mass of the catalyst decreases.’
- 08.3** Less than a tenth of students scored any marks with the majority of these gaining 1 mark, mainly for identifying Y as the ‘substrate’. ‘Catalyst’ and ‘enzyme’ were common incorrect responses for both X and Y. Some gave descriptions such as hand, glove and rocks.
- 08.4** Only about an eighth of students correctly named the model as ‘lock and key.’ ‘Enzyme model’ or ‘enzyme action’ were common incorrect responses.
- 08.5** Just over a quarter of students scored 1 mark which was predominantly for realising the temperature should be the same. Insufficient responses included:
- so, it is a fair test
 - the water bath as the control variable without mentioning temperature
 - so, there are accurate results
 - references to pH.
- 08.6** A third of students did not attempt this item and nearly half scored 0 marks. Several gave the insufficient response ‘iodine’ for marking point 1. The fifth of students that gained marks largely did so for the correct colour change.
- 08.7** Two thirds of students identified the correct pH range.
- 08.8** Less than a tenth of students obtained a mark although all options given in the mark scheme were seen. Often the answers were poorly expressed. Some said ‘repeat’ without reference to a mean. Others talked about using a different method.

Question 9 (standard demand)

- 09.1** Nearly three fifths of students correctly determined the acceleration using a reading from the graph. The most common incorrect response was $20 \times 6 = 120$, and $20 \div 6$ was also seen.
- 09.2** This was less accessible than question 09.1. Just under two fifths of students correctly calculated the distance. Working was not always shown clearly. $S = 6 \times 20 = 120$ m was a common error.

Some students added $120 + 270 = 390$ m instead of finding the difference.

- 09.3** A quarter of students gained both marks and a third gained 1 mark for the tick box only. Some students compared the times of 6 s and 20 s or calculated and compared 0.3 m/s^2 and 1.0 m/s^2 , which was acceptable. A common insufficient response described the gradient or line as going down faster.
- 09.4** Three quarters scored 0 marks and a fifth did not attempt it. The majority of students who attempted this item chose the wrong equation from the Physics Equations Sheet. $80 \div 16 = 5 \text{ m/s}^2$ and $16 \div 5 = 3.2 \text{ m/s}^2$ were common miscalculations.

Question 10 (standard demand)

- 10.1** Nearly half of the students did not attempt this question to plan a method. Just over a quarter who did were not awarded any marks. The remainder largely achieved 1, 2 or 3 marks.

Common errors were:

- no reference to any equipment
- assuming that citric acid was a liquid not a solid
- weak references to measuring the lowest temperature
- not identifying the key steps.

- 10.2** Just over a third of students identified the correct reaction profile for an endothermic reaction with almost as many choosing the exothermic profile.
- 10.3** Just over a fifth of students gained credit, mainly for identifying that powder has a greater surface area. Very few students also said that the frequency of collisions would increase. A few insufficiently said 'more collisions' with no reference to time. Many students incorrectly said lumps had a greater surface area. Some thought that a reduced surface area would mean more collisions.

Mark Ranges and Award of Grades

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