



GCSE

Combined Science: Synergy

8465/3H Paper 3 Physical Sciences Higher Tier

Report on the Examination

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General comments

There were 9 questions on this paper. Question 1 was predominantly testing biology content, questions 2, 5 and 8 were physics and questions 3, 4, 6, 7 and 9 were chemistry. The questions are designed to increase from standard demand to high demand through the paper.

This paper also contained items targeting mathematical and practical skills. Most students showed the method of their working when completing calculations. It can be difficult for examiners to credit responses if they cannot clearly follow the method the student has used. Even simple ones that are easily done on a calculator should be included. Access to the Physics Equations Sheet seemed to benefit students. Many students seemed unfamiliar with laboratory techniques and equipment. Questions 01.5–01.8 targeted RPA20, and question 03.1 targeted RPA18 in this 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** About a third of students identified the type of molecule as a 'protein'.
- 01.2** About two thirds of students knew that the mass of a catalyst stays the same during a reaction.
- 01.3** Less than a third of students gained both marks. 'Active site' was more familiar than 'substrate'. Common errors included catalyst, amylase and sugars.
- 01.4** Just over half of students knew this model. Some incorrectly said 'enzyme model', 'enzyme action' or 'enzyme-substrate complex'.
- 01.5** Over half of students gained marking point 1 for recognising the temperature would be the same. Several gave the insufficient response of 'fair test'. Very few referred to the effect of temperature on amylase for marking point 2, although many mentioned reaction rate.

- 01.6** About a fifth of students gained both marks. About a third gained no marks. Writing ‘iodine’ or ‘iodine test’ was insufficient for marking point 1. As marking point 2 is an independent mark the colour change was still accessible.

‘Biurets’ and ‘Benedicts’ were seen as well as various incorrect colours, including the omission of ‘dark’.

- 01.7** Nearly all students identified the correct pH range.

- 01.8** ‘Use a pH probe’ was a common incorrect response, as well as ‘repeat’ without a reference to a mean. About two fifths of students scored a mark, with examples of all the options on the mark scheme seen.

Question 2 (standard demand)

- 02.1** Nearly all students gained both marks for the calculation of acceleration.

- 02.2** About four fifths of students gained both marks for calculating the distance. A common error was to use time as 20 s instead of 25 s, hence giving a response of 120 m.

- 02.3** About two thirds of students gained both marks for comparing the deceleration and acceleration of the car. Marking point 2 was mainly awarded for ‘a steeper line’ or for comparison of the times as 6 s and 20 s.

- 02.4** About a third of students got 3 marks for this calculation of acceleration, whilst the rest mainly got 0. A common incorrectly calculated value of acceleration was 3.2 from $16 \div 5$.

Question 3 (standard demand)

- 03.1** Students found planning a method for this investigation difficult. Nearly a third of students got 0 marks or made no attempt. Less than a fifth gained a Level 1 response of 1 or 2 marks. About a third gained 3 or 4 marks. About a fifth of students described a valid method and scored 5 or 6 marks.

Common weaknesses were:

- using incorrect units such as cm or cm²
- assuming citric acid was a liquid
- choosing to use test tubes for the reaction which would not hold the volume stated
- missing out a suitable container all together
- not naming the equipment or the measuring instruments used
- poor descriptions of measuring the lowest temperature, several involved time limits.

Both methods were described. The majority chose to repeat each experiment with different masses rather than continuously add citric acid to the same solution.

- 03.2** About two thirds identified the correct reaction profile for an endothermic reaction.
- 03.3** About three fifths of students gained 1 mark for recognising powder has the larger surface area. About a fifth got both marks. 'More collisions' was a common insufficient answer, missing the required reference to time.

Question 4 (standard & standard/high demand)

- 04.1** Nearly three fifths of students scored this mark, generally for stating that comparisons can be made. Incorrect responses included 'easier to read', 'to make it a fair test' or that 'it's more accurate'.
- 04.2** Nearly all students scored at least 1 mark for the evaluation of shirt production in this extended response question. This was mainly for making at least 2 numerical comparisons, or for calculating the total impacts including a comparison.
- About two fifths wrote a Level 2 response which included a judgement. Three quarters of these made reference to all 3 processes so were awarded 4 marks.
- 04.3** 'Avoidance of bias' was the most common response for the mark awarded to roughly two thirds of students. 'Check for accuracy' was also frequently seen.' Several students understood the use of 'independent' to mean the scientist was on their own.
- 04.4** A quarter of students correctly named both biological methods. Three fifths got no marks or did not attempt the question. One mark answers seemed fairly evenly distributed between the two methods.

Question 5 (standard & standard/high demand)

- 05.1** Over half of students scored 0 marks or did not attempt, this explanation of why step-up transformers are used in the National Grid. Less than a quarter gained 1 mark, mainly for marking point 1. About a fifth gained 2 or more marks with very few getting 4.
- Generally, very weak technical language was used. Very few students referenced the cables. Some used the absolute term that there was 'no heating/energy loss' rather than 'less'.
- 05.2** 'Electricity' or 'current' were often substituted for 'potential difference' or 'voltage'. About a quarter of students got both marks and two fifths got 0.
- 05.3** Over two fifths of students correctly calculated the current in the secondary coil. About a third got 3 marks, generally for not including the conversion from kV to V. Some incorrect responses involved attempts to use $V = I R$.

- 05.4** About half of students got 0 marks, or did not attempt, this comparison of the environmental impact of different types of power station. The other half predominantly got a Level 1 answer with 1 or 2 marks.

Knowledge of the impact of nuclear power stations was particularly weak. Coal power station references were mainly about greenhouse gases and/or global warming. The command word is 'compare' so comparative comments about the impact of both were required for full credit.

Question 6 (standard, standard/high & high demand)

- 06.1** Nearly three quarters of students correctly named Group 0 elements as noble gases. The most common incorrect response was 'halogens'.
- 06.2** Just over two fifths of students got both marks. A common incorrect response was reference to the change in reactivity going down the group. An insufficient answer for marking point 1 was 'less reactive.' For marking point 2 some incorrectly said there were 'no electrons on the outer shell'.
- 06.3** Just over half of students gained this mark for the relationship between relative atomic mass and boiling point in Group 0.

Errors included:

- using absolutes rather than comparatives
- attempts to explain rather than describe the relationship
- saying boiling point increases going down the group.

- 06.4** Over four fifths of students correctly completed the electronic structure of fluorine. There were some 2,5 electronic configurations and some added rings.
- 06.5** A third of students gained a mark for this multiple choice question but it was also the most commonly chosen distractor.
- 06.6** About a fifth of students gave 2 correct observations, and two thirds gave one. The most common marking point was 'effervescence/fizzing/bubbles'. Students often wrote 2 of these so were only credited once. Several referred to flames which was not creditworthy.
- 06.7** Roughly two fifths of students gained some credit, mainly 1 mark and some 2 marks. Very few gained full marks.

Marking point 1 was most common and often expressed as '(lithium) has fewer shells', or the converse. Marking point 2 was rarely awarded as the detail about 'attraction' and 'the nucleus' was usually missing. The outer electron was not always referred to, just electrons in general. Another misconception included reference to the reactivity series.

- 06.8** Very few students gained any marks for this high level skill. About a third gained one mark, mainly for H₂.

Question 7 (standard/high demand)

07.1 Roughly half of students got 0 marks or did not attempt this question describing the processes to form an ionic bond when magnesium and oxygen reacted. About a tenth got all 4 marks and a quarter got 3 marks. Those that got credit generally knew 2 electrons were involved in the bonding.

Common errors were:

- descriptions of sharing electrons or covalent bonds which prevented the award of marking point 1 and marking point 2
- stating general observations about the reaction
- saying ‘oxygen ion’
- not referring to ions having full outer shells
- insufficiently saying positive and negative.

07.2 This graph question was answered well and nearly three quarters of students scored 3 marks. About a fifth gained 2 marks. Unnecessary lines of best fit were often added, and these were ignored.

07.3 This item was a test of the definition of precision. It was not answered well with about an eighth of students getting a mark. Students who made references to ‘reliable’ or ‘inaccurate’ were not credited with a mark.

Common misconceptions were:

- points don’t fit the line of best fit
- not using equal intervals of mass of magnesium reacted
- no pattern in the results
- not enough results.

Question 8 (standard/high & high demand)

08.1 Students were generally unable to explain the physics behind the collision. Correct terminology was lacking and understanding was weak. About a tenth of students gained 1 mark, mainly for marking point 3.

Misconceptions included references to:

- air pressure
- soft plastic
- large surface area of the bodysuit
- the impact, not the impact time
- absorbing energy/momentum
- slowing down forces.

08.2 Over half of students gained 4 marks for calculating the value of velocity as +3.5, although very few scored all 5 marks for the value of –3.5. Some students tried to use $E_k = \frac{1}{2} m v^2$. A fifth scored 0 marks.

08.3 This question differentiated well for the students who understood the link between gravitational potential energy and kinetic energy.
Over half gained marking point 1 and marking point 2 for the calculation of gravitational potential energy. Just under a fifth went on to use this value to calculate the speed.

About a fifth of students scored 0 marks. Some students attempted calculations of momentum or weight.

08.4 Nearly all students were unable to explain this situation and scored 0 marks, with none achieving 2 marks. A common error was to say that ‘momentum slowed down’. Many students made reference to the ground, and sometimes gave descriptions not explanations.

Question 9 (standard, standard/high & high demand)

09.1 A quarter of students did not attempt this item and two fifths correctly named ‘alkanes’.

09.2 A third of students gave the correct general formula and a fifth did not attempt it.

09.3 Three quarters of students gained 0 marks indicating poor understanding of this process.

Common errors included:

- not referring to molecules at all
- referencing the number of carbon and/or hydrogen atoms without linking to the molecule
- calling intermolecular forces ‘bonds’ without qualification
- implying that the C–C and C–H bonds are the ones that need to be overcome for boiling.

09.4 A quarter of students were able to complete the equation and gain both marks. Over two thirds scored 0. A common incorrect response was ‘ $C_2H_6 + C_4H_8$ ’ - students are expected to know the formula of ethene which is an AO1 (knowledge & understanding) skill.

09.5 About a fifth of students gained full marks for this high level bond energy calculation. An eighth did not attempt it, a third scored 0, and all other marks were fairly evenly distributed.

Marking point 1 was commonly obtained, and marking point 2 was often incorrectly calculated for a variety of reasons. Marking point 3 and marking point 4 were not awarded if 814 was not used or used incorrectly. Students were told that the energy released forming new bonds was 814 kJ/mol greater than the energy needed to break bonds. Therefore no ‘allow’ was given for marking point 4 if they had assumed an endothermic reaction. Students often scored marking point 5 for recognising that the final answer should be divided by 4.

Mark Ranges and Award of Grades

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