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GCSE

COMBINED SCIENCE: SYNERGY

8465/3H Physical sciences
Report on the Examination

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General

There were 10 questions on this paper. Questions 1, 2 and 3 were common with the Foundation tier.

Questions 2, 4, 7 and 10 were predominantly physics content and the others chemistry.

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.

Many students seemed unfamiliar with laboratory techniques and equipment. Q3 targeted RPA17 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

The questions are designed to increase from standard demand to high demand through the paper. A student's final grade is based on their attainment across the qualification as a whole.

Question 1 (standard demand)

1.1 Nearly all students gained 1 mark for identifying lithium.

1.2 About two thirds of students were able to show that lithium forms a positive ion.

Common incorrect responses were:

- loss of electrons
- gain of an electron
- an incorrect reference to particles

1.3 About a third of students knew that a mixture of metals is an alloy. A common incorrect response was copper oxide.

1.4 Over half of students gained 3 marks. Some read the graph incorrectly, usually as 58%, but went on to use this value correctly. The other main error was to multiply 59 by 20 with no division by 100.

1.5 Students found this question difficult with just over 40% of students gaining 1 mark but few were then able to go on to develop their explanation. MP3 was the most commonly awarded mark point. However, a comparative was needed with the idea of 'sliding less easily'. Saying 'not sliding at all' is too absolute.

Students often wrote insufficient responses about the size of copper and size of metal **X** without referring to atoms. Students often referred to bonding and intermolecular forces.

1.6 Only a quarter of students gained credit with most of those just scoring 1 mark.

Very few students wrote 'giant structure'. Some negated 'strong bonds' by naming an incorrect type of bonding, or referring to intermolecular forces. Others gave insufficient responses about forces instead of bonds. Some wrote about 'lots of bonds' with no reference to energy. Some responses were just general properties of metals or referred to delocalised electrons or outer shell electrons.

1.7 Under half of students gained credit.

Insufficient responses included:

- electrons without stating the electrons were delocalised or free to move through the metal
- copper is a metal

Question 2 (standard demand)

2.1 Nearly all students were able to identify the equation.

2.2 Two fifths of students correctly determined v = 24 m/s from the graph and then used this to calculate the mass for 4 marks. A third of students gained 0 marks.

Common errors included:

- using a value of 6.0 for v.
- using 24 instead of 24^2.
- incorrect conversions or steps after the initial calculation.

When asked to use a figure, students could benefit if they show their method from, or on, the figure.

2.3 The vast majority of students gained 1 mark. The most common incorrect response was 'gravitational potential energy is transferred to kinetic energy'.

2.4 Less than a fifth of students gained 2 marks and about two fifths scored 1 mark.

For the first marking point, friction or lubrication needed to be linked to the brakes to gain credit. Unscientific terms such as 'slippery' were not credited.

Incorrect responses for the second marking point included saying 'increases stopping time' or 'takes longer to stop' which refer to time rather than distance.

Some students repeated the question and said it affected the distance without saying how. 'Stops more slowly' was another incorrect way students expressed what happened to the carriage. Responses including kinetic and thermal energy were also seen.

2.5 The definition of thermal conductivity was not well known and only one third of students gained at least 1 mark. The majority of these only gained 1 mark, predominantly for 'good conductor'. Very few references to 'rate' were seen.

Errors included:

- material having the ability to withstand high temperatures.
- references to energy absorption / emission.

- material does not melt.
- electrical conductivity.
- incorrect energy transfers.
- references to friction.

Question 3 (standard demand)

3.1 Only a fifth of students gained both marks. A third gained 1 mark, mainly for ‘carbon dioxide’ rather than for ‘water’.

Common incorrect products were:

- hydrogen.
- hydrochloric carbonate.
- copper compounds.

3.2 Descriptions of the salt preparation method were not well done. Just over a tenth of students described a valid method and scored 5 or 6 marks. About a third gained 3 or 4 marks. Just under two fifths gained 1 or 2 marks.

Common errors were:

- starting with calcium chloride.
- assuming that calcium chloride is a liquid or a solution.
- not adding an excess of the carbonate.
- not filtering the mixture.
- describing filtration as going through a funnel without the paper.
- just leaving the ‘solution’ on the side.
- not identifying suitable containers eg using a petri dish on top of a flame.
- strongly heating with a Bunsen burner rather than using a heater or a water bath.
- heating to dryness.

Question 4 (standard / standard/high demand)

4.1 Only about a fifth of students gained 1 mark. Students often described the graph or the shape of the wave with insufficient responses such as goes ‘up and down, or ‘above and below zero’. A description of change in polarity was accepted.

4.2 About a third of students gave 230 V as the potential difference of the UK mains electricity supply. Incorrect responses included 220 V, 250 V, 50 V and 50 000 V.

4.3 About a third of students gave 50 Hz as the frequency of the UK mains electricity supply. Incorrect responses included 230 Hz and 40 000 Hz.

4.4 About three fifths of students knew the function of the Earth wire. The most common distractor was ‘to carry the alternating potential difference from the supply’.

4.5 About a fifth of students gained 1 mark with very few being able to develop their description to gain more marks.

The idea of there being ‘no power’ when S_1 is open was mainly missed. Students did not often reference ‘power’ at all. This limited them to the compensation mark for a description of the

switches turning on different parts of the circuit. Identifying that S_1 and S_2 are switches and that the circuit is parallel was insufficient for credit.

Terminology used for current, power and the role of a switch in a circuit was weak.

4.6 About two fifths of students gained the full 4 marks for this calculation of time. Working was generally shown clearly.

The most common error was to use an unconverted value of energy and two fifths of students gained 3 marks. The other frequent error was to multiply energy by power.

Question 5 (standard/high demand)

5.1 About a third of students completed the dot and cross diagram correctly.

Incorrect responses included:

- the addition of extra electrons.
- drawing of the bonding pair outside the overlap.

5.2 One fifth of students gained 1 mark for the limitations of this model, with very few gaining both marks.

Marks were mainly awarded for:

- the idea that the model is 2D or the molecule is 3D.
- only shows the outer shell of electrons.

References to size were insufficient unless it was about the relative sizes of the atoms, as were remarks about bonding.

5.3 Very few students gained 3 or 4 marks. About two fifths of students gained 1 or 2 marks. The most commonly awarded marking points were ‘temperature (of column) decreases from bottom to top’ and ‘hydrocarbons have different boiling points’.

Insufficient reference to heating crude oil without the idea of vaporisation was common. Descriptions of fractions condensing at different heights were usually weak.

5.4 Less than a tenth of students gained both marks.

Comparative answers were required and not always given. The word ‘molecule’ was needed for the first marking point and frequently omitted. Several gave the same trend for viscosity and flammability. Some students gained 1 mark for a general link between molecule size and the trends without referring to kerosene and fuel oil.

Some students seemed to think there are different sized kerosene molecules and different sized fuel oil molecules.

5.5 About a quarter of students gained 1 mark. Some supported their knowledge of the general formula by applying it to $C_{10}H_{22}$.

5.6 The scaffolding was intended to guide students through the determination of the hydrocarbon formula. However, several did not follow the instructions so could not gain credit without a clear method. Less than a tenth of students gained 4 marks or above.

Sometimes marks were given for the ratio which was then not used to determine the formula. Some students also gained marks for both of the 'allow' statements. The term 'empirical formula' seemed unfamiliar to many students.

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

6.1 About half of students were awarded 2 marks for this calculation. A common error was to incorrectly divide the two numbers, mainly 7.24/0.25 rather than 0.25/7.24.

6.2 Roughly only a quarter of students were able to give the formula of aluminium sulphate. $Al_3(SO_4)_2$ was the most commonly chosen distractor although as many chose the other two distractors between them.

6.3 Less than a twentieth of students gained this mark.

Common errors included:

- references to pH.
- references to concentration.
- not stating 'in aqueous solution'.

6.4 About two fifths of students correctly named a weak acid. Citric acid was the most common correct answer. Hydrochloric acid was a common error.

6.5 Just under half of students were able to determine how the H^+ ion changed. 'Decreases by a factor of 10' was by far the most common incorrect response.

6.6 Very few students gained any marks for this high level skill.

Incorrect responses included:

- not knowing the formulae of NaOH and H_2SO_4.
- writing word equations.
- writing symbols or subscripts as large as the letter.
- not using the given information that sodium sulphate and water were products.

Question 7 (standard/high demand)

7.1 Few students were able to score 1 mark and only a very small number gained 2 marks for this explanation.

Several students gave insufficient definitions of distance and/or displacement and mainly did not say that distance was greater than displacement. Other insufficient responses were about scalar and vector quantities without using that information in an explanation.

Answers should also refer to the car rather than generic statements.

7.2 Roughly one third of students gained one mark but very few were then able to develop their answer to gain further credit. The application of forces to this situation was not well explained.

Common misconceptions included references to:

- energy transfers.
- gravitational potential energy and kinetic energy.
- momentum.

- mass.
- gravity.

The definition of Newton's first law was poorly answered. Attempts at the second and third laws were also seen. The idea of direction for both movement and forces was often missed. The most commonly awarded mark was for the third marking point regarding prevention of the collision. It needed to be clear it would be an injury from a forward movement.

7.3. About two fifths of students gained one mark but very few were then able to develop their answer to gain further credit. The most common mark was for the comparison of the time taken to stop from Table 1.

Common errors were:

- saying 'deceleration is slower' rather than 'deceleration is less'.
- confusing deceleration and time.

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

8.1 Just over a third of students scored 1 mark for this prediction from a graph. 60% and 61% were the most commonly seen answers in the range. Common incorrect responses included 78%, 80%, 90% and 70%.

8.2 About two fifths of students gained one mark but very few were then able to develop their answer to gain further credit. Those gaining credit mainly scored 1 mark for recognising the trend.

Common misconceptions included references to:

- collision theory and rate of reaction rather than the chemistry of equilibrium reactions.
- evaporation.
- boiling points.
- kinetic energy.
- denaturing enzymes.
- pressure.

8.3 About a fifth of students did not attempt this item. Less than a fifth of students gained 1 mark, mainly for the term 'closed system'. Incorrect references to changing the pressure and/or temperature were common.

8.4 Students were told that a catalyst is used to increase the rate of the reaction. Only then just under one fifth of students were then able to add value to the statement.

8.5 Students found this high demand question very difficult with under 20% gaining a mark. The two marking points were independent of each other.

Very few students recognised that the catalyst would not affect the yield. Responses relating to changing the rate of reaction or changing the activation energy were usually for one direction only.

Question 9 (standard/high / high demand)

9.1 About a fifth of students gained the full 3 marks for this calculation using the Avogadro constant. Roughly a quarter gained 2 marks. This was usually for not converting the answer to 3 significant figures or not including the 'x 10^{22}'.

9.2 Students found this question very difficult with over four fifths scoring 0 marks and over an eighth did not attempt it. A common incorrect response was to include Na and/or H in the equation. Some students wrote word equations.

9.3 Less than 10% of students gained any credit in this demanding explanation about the production of hydrogen gas.

Very few students explained that the ions come from the breakdown of water. Students rarely referred to H^+ or hydrogen ions, if they did it needed to be clear they were from the water.

Students often recognised that ions would move to the negative electrode but did not gain credit by:

- failing to say the ions gained electrons.
- saying that the ions lost electrons.

The final marking point was often missed by the omission of 'molecule' when referring to hydrogen.

References to the reactivity of sodium and chlorine were common but not creditworthy.

Question 10 (high demand)

10.1 Over a half of students gained 0 marks for this item requiring an explanation of why a wire moves when a switch is closed.

About a third of students gained 1 mark, usually for saying that a current flows in the wire and a minority also said that the current caused a magnetic field around the wire. The explanations as to what happens after the current flows were poor.

Common incorrect physics included:

- poor understanding of the role of the switch in this circuit.
- references to electrostatic force.
- 'electricity' being used for 'current'.
- weak explanations of the interaction between the two magnetic fields.

10.2 This multi-step extended response calculation was answered very well. Nearly three fifths of students gained 5 or 6 marks, predominantly 5 marks for not converting the magnetic flux density correctly. Students needed to start with a correct method to calculate current to access the last 3 mark points.

A common error for lower scoring students was to use the potential difference value of 0.14 V as the current.

Mark Ranges and Award of Grades

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