GCSE
CHEMISTRY

8462/1H: Paper 1 - Higher
Report on the Examination

8462
June 2019

Version: 1.0

General

Students appear to have been well prepared for this paper.

There were 9 questions with questions 1 – 3 being common with the Higher Tier. The demand levels of the questions are designed to increase from standard demand to high demand through the paper, and as expected, students had more difficulty gaining credit in the high demand questions towards the end of 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.

Question 1 (standard demand)

01.1 Approximately 40% of students scored this mark which required an appropriate reference to the properties of tellurium and/or iodine.

Most correct answers referred to iodine having similar properties to other Group 7 elements.

References to atomic structure were quite common, for example, iodine has 7 electrons in the outer shell so fits in Group 7. This was not creditworthy since this detail of atomic structure would not have been known by Mendeleev.

01.2 Students found this question difficult with almost half scoring 0 marks.

The most commonly awarded mark was for the idea that the missing elements were eventually discovered.

The ideas that Mendeleev predicted the properties of the missing elements and that when discovered the actual properties matched his predictions were not often stated.

01.3 Approximately three-quarters of students correctly identified relative atomic mass as the modern name for atomic weight.

01.4 Approximately 70% of students scored this mark with the most common response being 'atomic number'.

The most common responses seen that were not credited:

- reactivity
- relative atomic mass
- mass
- number of electrons in the outer shell.

01.5 Almost 70% of students scored at least 1 mark.

To gain the mark for the formula, At_2, the correct casing for the letters needed to be used; also, a subscript for the number. This mark was scored more often than the mark for the state.

01.6 Students found this question difficult and were often unable to give the observations associated with the reaction between sodium and chlorine.

The few students that gained credit mostly did so for the formation of a solid or for a flame.

Many students gave observations that would be expected from adding sodium to water, for example, a vigorous reaction or fizzing.

Other common non-scoring responses referred to:

- a precipitate being formed
- salt or sodium chloride being produced
- transfer of electrons.

Question 2 (standard demand)

02.1 Approximately 80% of students correctly identified H^+ as the ion produced by all acids in aqueous solution.

The most common incorrect response was OH^-

02.2 Almost 60% of students scored both marks for completing the word equation.

The name of the acid was more widely known than the name of the missing product.

A common incorrect response for the product was hydrogen.

02.3 The name ‘burette’ was well known. Phonetic equivalents of this word also scored the mark but not ‘biuret’ (as this is a reagent used in biology).

Other common incorrect responses included:

- pipette
- syringe
- measuring cylinder.

02.4 Approximately 70% of students were able to take a correct reading from the burette scale.

The most common incorrect answer was 28.4 cm^3.

02.5 Students appeared to be well prepared for this extended response question which drew on their experience of a required practical activity.

Approximately 60% of students achieved a Level 3 mark by identifying and logically sequencing all the key steps for this titration.

The most common key steps to be omitted were:

- measuring the volume of the acid
- adding an indicator.

Question 3 (standard demand)

03.1 Most students scored a mark for referring to the presence of delocalised electrons in carbon nanotubes.

Only a small proportion scored the mark for explaining the role of these electrons in the conduction of electricity.
Some students only referred to the delocalised electrons being able to carry charge without further qualification.
Others were not sufficiently precise in describing the movement of electrons <u>through</u> the structure. This implies movement in a particular direction as opposed to random movement, for example, <u>around</u> the structure.

03.2 Almost all students made an attempt at comparing the properties of the three materials.

Most achieved a Level 2 mark by giving a consequence of one of the stated differences in properties. Many gave a justified conclusion in referencing the most suitable material for the racket frame.

03.3 Almost 70% of students scored full marks. Of those that didn't, most scored 2 marks for calculating the surface area as 40344 nm^2 but incorrectly converting or not converting this answer to standard form.

Even if the answer to their calculation was incorrect, a mark could still be scored for correctly converting this answer to standard form, provided that an attempt to calculate the surface area had been made.

03.4 Almost half of students scored this mark.

The most common correct response referred to nanoparticles having a greater surface area to volume ratio (compared to fine particles).

Some students linked the greater surface area to less zinc oxide being needed for the same effect. This covered both alternative bullet points in the mark scheme.

Common responses seen that were not credited included:

- nanoparticles are smaller
- nanoparticles are easier to manufacture
- less energy is required.

Question 4 (standard and standard/high demand)

04.1 Approximately 80% of students scored both marks for the names / properties of the proton and the neutron.

04.2 Approximately 70% of students gave the correct definition of mass number.

However, there were some incorrect references to mass, for example, 'mass number is the total mass of the protons and neutrons'.

04.3 Approximately 80% of students correctly answered that isotopes of the same element have different numbers of neutrons.

04.4 Most students made a good attempt at this question about the alpha particle scattering experiment.

The marks for the ideas that some particles were deflected and/or reflected and that there is a charged nucleus were the most frequently awarded.

The mark for the idea that most of the particles passed straight through the gold foil was the least frequently awarded.

Those students gained fewer marks tended to focus on expected outcomes but didn't know exactly what happened in the experiment.

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

05.1 Approximately three-quarters of students were able to complete the dot and cross diagram correctly.

The mark for the bonding electrons was scored more often than the mark for the non-bonding electrons.

05.2 Only a small proportion of students were able to give a limitation of a dot and cross diagram.

The most common correct response was that the molecule was not shown in 3 dimensions.

Common responses seen that were not credited included:

- only shows the outer electrons
- does not show the structure
- does not show the intermolecular forces.

05.3 Students found this question difficult.

The mark for indicating the presence of weak intermolecular forces was most often awarded. However, some students referred to 'intermolecular forces' incorrectly, for example, weak intermolecular forces between the atoms / bonds.

A common misconception was that covalent bonds are weak and that it is these bonds that are broken when ammonia boils.

Ammonia consisting of small molecules was the mark least often awarded.

05.4 Students found identification of a metal oxide most likely to be used as a catalyst difficult.

The correct answer, the transition metal oxide, Cr_2O_3, was the most common choice of catalyst but the other 3 options were all chosen in significant numbers, especially MgO.

05.5 Approximately two-thirds of students correctly calculated the overall energy change.

The most common error was to incorrectly determine, or not determine, the number of each type of bond from the given equation.

05.6 Students found this question challenging. In particular, students did not always use values from their previous calculation as instructed in the question. A common non-scoring response was simply to define an exothermic reaction.

Few students compared their calculated values for bond breaking and bond making as was intended. Some referred in general terms to these processes but often used incorrect terms, for example, more energy was <u>needed</u> for making bonds than used for breaking bonds.

05.7 The completion of the energy profile was often done well with almost two-thirds of students scoring both marks.

Some students were imprecise with the positioning of their lines.

Other common errors included:

- Not drawing a line for activation energy, just labelling the peak.
- Drawing a line from the peak to the products line for ‘overall energy change’.

Question 6 (standard and standard / high demand)

06.1 Students found this question difficult and were quite often imprecise in their description of the control variables. The use of the word amount is unlikely to gain credit and students should be encouraged to use scientific terminology such as ‘volume’.

The most common control variables given were volume of solution and concentration of solution.

Common responses seen that were not credited included:

- amount of solution
- the electrolyte
- the copper electrode.

06.2 Most students scored the 2 marks for the order of reactivity of the top four metals and the justification for this order.

The most common error was then to put silver above copper in the order of reactivity.

However, only a small proportion of students were able to explain the negative voltage for silver in terms of its reactivity compared with copper.

06.3 Approximately half of students correctly identified ‘magnesium and tin’ as the pair of metals to produce the greatest voltage.

‘Magnesium and cobalt’ was a strong distractor, presumably because it also contained the most reactive metal.

06.4 Only a small proportion of students scored both marks. The mark for describing the reaction that produces water in a hydrogen fuel cell was the least frequently scored.

Often, students gained the compensation mark for the idea that hydrogen fuel cells produce water.

However a significant number of students gave incomplete responses indicating that hydrogen fuel cells produce steam (with no reference to water).

Some common misconceptions seen were:

- Hydrogen fuel cells release hydrogen gas.
- Hydrogen burns in a hydrogen fuel cell.

Question 7 (standard, standard / high and high demand)

07.1 The explanation for the use of cryolite in the extraction of aluminium does not appear to be well known. Almost two-thirds of students scored 0 marks.

A common misconception was that cryolite acts as a catalyst.

Common responses seen that were not credited included:

- to melt the aluminium oxide so that it conducts electricity
- so that the ions can move freely
- to reduce costs.

07.2 Almost 60% of students correctly identified that aluminium ions gain electrons as the process occurring at the negative electrode.

07.3 Students found the completion of the half-equation difficult. Almost 70% scored 0 marks.

Common errors included:

- including Al / Al_2O_3
- representing the oxide ion as O^- or O_2^-
- 2 electrons rather than 4 electrons being produced.

07.4 However, only approximately a quarter of students were able to state why the positive electrode needs to be replaced and hence score all 3 marks.

07.5 Most students scored at least 1 mark. Approximately 40% scored all 4 marks.

The most frequently scored mark was for M_r (Al_2O_3) = 102 (or '204' from the alternative approach in the mark scheme).

A common error was M_r (Al_2O_3) = 156 but students were still able to score marks for using this incorrect value in subsequent steps.

A valid variation on the reacting mass method was to calculate the percentage by mass of oxygen in Al_2O_3 and then use this to calculate the mass of oxygen in 2000 kg of Al_2O_3

It was not always clear which approach was being used. A common incorrect final answer was 1412 (kg) where students had applied the 2 : 3 mole ratio (from the main approach) as well as the 96 / 204 mass ratio (from the alternative approach).

07.6 Students found this question difficult. Almost two-thirds of students scored 0 marks.

Even when students realised that reactivity was the key idea, they sometimes compared the reactivity of the wrong species, for example, sodium and chlorine or Na^+ ions and H^+ ions

A common misconception was that sodium chloride solution does not conduct electricity.

07.7 Approximately two-thirds of students scored at least 1 mark for this calculation.

However, the most common final answer was 50.7 dm^3. The error here was the omission of the unit conversion, kg to g.

Question 8 (standard / high and high demand)

08.1 Only approximately a quarter of students scored this mark. They usually did so by identifying the need to ensure that the oxide of copper had completely reacted.

Common responses seen that were not credited included:

- to ensure complete reaction (unqualified)
- to ensure reliable / valid / accurate results.

08.2 Students found this question difficult. Approximately 80% of students scored 0 marks.

The idea that hydrogen is explosive was the most common correct response.

A common misconception was that, unless burned off, the hydrogen would affect the masses of the tubes and contents.

Common responses seen that were not credited included:

- Hydrogen is flammable.
- Hydrogen would react with the drying agent.

08.3 Students found the processing of the data quite difficult. Approximately a third of students scored both marks with a similar proportion scoring 1 mark.

Common responses seen that were not credited included:

- 1.09 g (which represents the mass of oxygen)
- 2.45 g (the mass of water) recorded as the mass of copper.

08.4 Students found this question difficult. Only approximately a quarter of students scored full marks with approximately a half scoring 0 marks.

For those who scored marks, it was usually by the main approach in the mark scheme. Here, the mark for linking the mole ratio to equation 2 was the least frequently scored.

All approaches in the mark scheme were represented and students scored best when their working was set out clearly.

The most common incorrect approach was to calculate the M_r of all the reactants and products in both equations and then simply refer to conservation of mass.

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

09.1 Almost a half of students scored 0 marks.

The mark scheme required the use of comparatives.

Common correct responses were:

- Better insulator
- Less heat loss

Common responses seen that were not credited included:

- good insulator
- no heat loss.

09.2 This graph question was well answered with approximately half of students scoring full marks.

Some students attempted to draw a straight line of best fit. In most cases, this was inappropriate.

Some students did not draw their line so that the two lines of best fit crossed. Instead, they drew a curved peak.

09.3 Approximately 60% of students were able to determine the neutralisation point from their graph.

In some cases, students misunderstood the scale of the x-axis, for example, reading 11 cm^3 as 10.1 cm^3.

09.4 Only approximately a third of students correctly determined the overall temperature change for the reaction from their graph.

A common incorrect answer was 8.2 °C (from subtraction of the highest and lowest temperature values in the table).

09.5 Students found this titration calculation difficult and approximately a third of students scored 0 marks.

The marks for calculating the number of moles of sulfuric acid and for calculating the relative formula mass of potassium hydroxide were the most scored. Even when these values were incorrect, this did not prevent students from gaining marks in subsequent steps.

The correct answer for the concentration in mol/dm^3 was achieved more often than the subsequent conversion to g/dm^3. A common error was to use a conversion factor of 112 ($2 \times M_r$(KOH)) rather than 56.

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.