AQA

GCSE
CHEMISTRY

8462/1H Paper 1 Higher Tier
Report on the Examination

8462
November 2020

Version: 1.0

General Introduction to the November Series

This has been an unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners will summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

There were just over 600 entries for the paper, compared to over 100 000 in a normal summer series. A full range of abilities was seen.

Comments on Individual Questions

Question 1 (standard demand)

01.1 Few students scored both marks. Diamond and sodium chloride were both commonly seen incorrect responses.

01.2 Many students were unable to reach the higher marks because they did not make direct comparisons. Instead, they gave separate descriptions of the three compounds. Many also referred to the properties of the compounds, which were not required. The phrase ‘intermolecular forces’ was used indiscriminately to describe interactions between ions or in giant covalent structures, as well as between molecules.

Question 2 (standard demand)

02.1 Nearly all students scored at least one mark. The most commonly seen incorrect response was ‘they form colourless compounds’.

02.2 Whilst many students realised that copper was displacing silver, most were unable to deduce that the grey crystals were silver and the blue solution was copper nitrate or a copper compound. There were many poorly worded answers which did not gain credit, such as ‘it displaced silver’, or ‘copper is blue in solution’. It was not uncommon for the grey crystals to be described as copper nitrate crystallising from the solution.

02.3 Whilst many students included a control variable in their plan, few actually said how they would identify each metal as magnesium, iron or copper, so were unable to access the higher levels.

02.4 This calculation was very well done by most students.

Question 3 (standard demand)

03.1 Many students failed to recognise or state that a reaction was taking place, merely referring to changes in mass on mixing. Some did not use the data in the question, as was required. Many students appeared to confuse conservation of mass with conservation of energy.

03.2 Most students realised that filtration would obtain the solid. Crystallisation was a commonly seen incorrect response.

03.3 Many students gave the answer 'sodium' as opposed to sodium nitrate, sodium iodide or sodium ions. Dust and bacteria were not uncommon responses.

03.4 Many students did not realise that heating was simply to dry the silver iodide, by evaporating off the water from the previous step.

03.5 This calculation was well done, although some students added up all four values of M_r instead of just those of the reactants.

03.6 Most answered correctly in terms of profitability, or reduction of waste. There was some confusion between atom economy and percentage yield.

Question 4 (standard and standard / high demand)

04.1 Students needed to give the idea of movement of the relevant ions to the positive electrode and to give a reason for that movement in terms of the attraction of opposite charges. Students often managed to convey one, but not both, of those ideas.

04.2 Only a third of students recognised that water provided the hydroxide ions. Vague references to the electrolyte were not sufficient.

04.3 Whilst many students realised that the solid was copper, some expressed this poorly, saying that copper ions were deposited on the electrode. Some students were able to explain the process in terms of the copper ions being reduced, or gaining electrons, but few scored all three marks by saying that the ions gained two electrons to form atoms.

04.4 Many students deduced that iodine would be the product at the positive electrode. Potassium was seen as the response to the product at the negative electrode far more often than hydrogen.

Question 5 (standard / high and high demand)

05.1 Students had difficulty in expressing their ideas clearly; electrons in the plum pudding model were variously described as 'floating' or 'covering' the atom rather than embedded in the atom. A popular misconception was that the plum pudding model had an overall positive charge. A large number of students lost credit by referring to protons and neutrons in the nuclear model, despite the timeline which showed they had not been discovered at the time of the development of the model. Some answers did not make it clear which model was being written about.

05.2 Many students stated that the Bohr model had electrons that orbit the nucleus, but fewer said that the orbits were at specific distances from the nucleus. Again, it was not uncommon to see mention of protons and neutrons despite the timeline provided.

05.3 Many students were able to deduce that the issue was that protons had not yet been discovered, but few also stated the relevance of the fact that the atomic number is the number of protons.

05.4 Few students could express coherently that the reason was to place elements with similar properties in the same group. There was a lot of imprecise language which did not earn credit; ‘reactivity’ is not the same as properties and placing elements ‘with’ those with similar properties does not necessarily mean in the same group or column.

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

06.1 Most students were able to express the idea that activation energy is the minimum energy required to start a reaction. One common error was to say that it is the energy needed to make particles collide.

06.2 A variety of approaches was seen. The majority of students calculated the number of moles of both aluminium and of iron oxide and then attempted with varying degrees of success to explain why the number of moles of aluminium was insufficient for the iron oxide. Common errors were to omit to convert the mass from kilograms to grams, and/or using 54 as the ‘M_r’ of aluminium. Of those who did correctly calculate the number of moles of each reactant, some had difficulty in expressing clearly the idea of 2 moles of aluminium being needed to react with 1 mole of iron oxide, and therefore 37.0 moles of aluminium is less than the 37.5 moles required, or that 18.75 moles of iron oxide is more than the 18.5 moles required. Other students started with the mass of one reagent and calculated the required mass of the other, either by the moles method or by proportion. These students found it easier to express why there was insufficient aluminium or excess iron oxide.

06.3 Few students scored both marks. Aqueous zinc was often seen as a response. Many students did not understand the idea of an ionic equation and tried to include the sulfate ion.

06.4 Only a third of students scored both marks, but a lot of students were confused about which species gained electrons and which lost them. Definitions of oxidation and reduction in terms of gain and loss of oxygen were not appropriate here and were not credited.

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

07.1 Many students spotted that the curve was for an endothermic reaction rather than exothermic. Many also realised the activation energy was incorrect but could not always express correctly that activation energy should start at the energy of the reactants rather than the products.

07.2 Most students did not score well on this question. There were many vague references to ‘better for the environment’ without any justification for that statement. Many students referenced the fact that water is the only product, failing to realise that rechargeable cells produce no waste products at all. Others failed to realise that the infrastructure for recharging cells is actually better than that for refuelling with hydrogen. Some students were effectively giving advantages of hydrogen fuel cells over petrol engines, instead of answering the question. Others failed to express themselves clearly; saying that hydrogen fuels cells take less time to charge which did not gain credit, as the cells are refuelled, not recharged.

07.3 Many students did not realise that either hydrogen or oxygen had to be a reactant. Many impossible species such as e^{2-} or O_2^+ were seen.

07.4 Many students were able to score at least one mark but only one in six scored both. Many noted that the movement of the particles was not shown; many also noted that the particles are not shown as diatomic, or that the forces between them are not shown.

07.5 This was quite well answered, with most students favouring compressing the gas rather than cooling to condense the gas. A number of students incorrectly stated that hydrogen can be taken in from the atmosphere.

07.6 A third of students were able to score full marks. It was not possible to give partial credit for working when the students did not explain what they were doing; too often there was a jumble of numbers with various operators between them, with no words or units. No credit was given for multiplying a value by 24 unless that value was identified as a number of moles.

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

08.1 The majority scored the mark, but many thought bromine is a solid at 0 ºC.

08.2 This question was not well answered. Most students stated that the boiling point increased going down the group, although some were evidently confused by the negative values in the table and stated the opposite trend. However, many students then confused boiling point with reactivity and tried to explain the trend using forces within the atom rather than forces between molecules. Students should refer to intermolecular forces rather than intermolecular bonds, to avoid any confusion about which 'bonds' they are referring to in terms of breaking them to make the substance change state.

08.3 This was very poorly answered. The idea of a bulk property was very rarely seen. There was considerable confusion between the terms atom and molecule, with many stating that bromine was diatomic so there are always two molecules. The best answers referred to the fact that boiling point relates to intermolecular forces, which cannot exist if there is only one molecule.

08.4 Many students realised that the fume cupboard would prevent inhalation of the gas, which is toxic. However, some students regard a fume cupboard as insulation to prevent the escape of heat energy, or thought it was to trap and retain the gas.

08.5 Most students knew and were able to express, that the atoms get larger going down the group. Some, however, referred incorrectly to the number of <u>outer</u> shells increasing. Fewer were able to express that there was a reducing attraction between the nucleus and the outer electrons or the incoming electron, with many vague references to shielding without mentioning the nucleus or the relevant electrons. Even fewer were able to express the increase in difficulty of gaining (rather than merely attracting) an electron.

08.6 Very few students scored full marks. Most students were able to calculate the mass of iron, but some calculated the mass of iron chloride instead of chlorine. They sometimes then assumed a formula of iron chloride and tried to work backwards. Of those who did calculate the masses of both iron and chlorine, most were then able to calculate the number of moles of each, but many then failed to find the simplest ratio as 1:3, instead leaving it as 0.08:0.24. Some calculated the number of moles of chlorine molecules instead of atoms; these students almost always failed to multiply by 2 to obtain the number of moles of atoms, giving a ratio of 2:3 instead of 1:3. Very few were then able to give a balanced equation; most did not use their ratio to give the formula of iron chloride as $FeCl_3$. It was rare to see the formula of chlorine written correctly as Cl_2, and iron was sometimes seen as Fe_2.

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

09.1 A third of students scored this mark; some realised that the most likely error was lack of stirring; fewer suggested that the temperature was measured too early, before the temperature had stopped falling. Many suggestions contradicted the information given.

09.2 Students had great difficulty in expressing their answers using correct terminology, often using energy and temperature interchangeably. They generally find endothermic reactions difficult; they do not seem to realise that the energy taken in is not staying as thermal energy but is being converted to chemical energy. Some students gained the mark for saying that the temperature initially falls because energy is being taken in, showing an endothermic reaction. A few noted that when 1.5 g of citric acid had been added the reaction had finished and that the citric acid was in excess from there on. However, it was very rare for a correct explanation for the subsequent rise in temperature to be given. Some thought the reaction suddenly became exothermic, or that it suddenly reversed (showing a lack of understanding of reversible reactions).

09.3 Many students realised that the difference was due to the better thermal conductivity of the metal. However, many of those merely referred to the metal as a good conductor, without comparing the metal to polystyrene. The majority of students drew a steeper line, stating that the metal would lose heat more quickly. Of those who drew the correct shallower line, few could explain that the metal would conduct thermal energy in from the surroundings more quickly, reducing the temperature drop in this endothermic reaction.

09.4 Many students were able to score all three marks. Common errors were to confuse concentration with number of moles and to fail to convert 250 cm^3 to 0.25 dm^3 correctly. The symbol 'm' for number of moles was commonly seen instead of 'n' – students consequently became confused between mass and number of moles. Students who set out their working step by step were able to gain partial credit, but those who simply had a jumble of numbers, with no explanation as to what the numbers represented, were not.

09.5 Most students scored at least two marks Some students referred to 'amount' of acid added rather than volume, and many failed to take any burette readings at all. It was not uncommon to see a conical flask placed 'under' a white tile rather than on one.

09.6 This was not well answered. Most students who scored a mark did so for stating that the acid could be added drop by drop, or that the rate of flow could be controlled. Few stated that the burette could measure variable volumes (unlike a pipette). Many stated that a burette was 'more accurate' but did not say what they were comparing it to. Of those who did, most said it was more accurate than a pipette, which is not true. Some students confused a volumetric pipette with a dropping pipette.

09.7 This titration calculation was well done by many students. To gain full credit, working needed to be correct as well as the final answer. Students therefore need to show their working step by step in a way that can be followed by the examiner. Common errors were to omit to convert volumes to dm^3, to attempt to do so but incorrectly, or to omit the mole ratio of citric acid to sodium hydroxide. As with question 09.4, students who incorrectly used the symbol ‘m’ to mean moles often confused themselves; they should be encouraged to use ‘m’ only for mass, and ‘n’ for number of moles.

Mark Ranges and Award of Grades

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