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General Certificate of Secondary Education

Additional Science 4408 / Chemistry 4402

CH2HP Unit Chemistry 2

Report on the Examination

2012 examination – June series

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Additional Science / Chemistry
Higher Tier CH2HP

General

Students demonstrated a wide range of ability, with all appearing to be able to complete the paper in the time allowed, and the majority attempting almost all questions.
While there were many excellent answers, the weakest students would have been better suited to the foundation tier paper.
Students are again reminded to write with black ink to maximise legibility.

Question 1 *(Standard Demand)*

(a) Only a small proportion of students gained credit. Common errors included to stop substances entering and contaminating the samples or affecting the experiment. Some students failed to gain credit as their answers were insufficiently specific, for example to prevent loss of liquids or substances, or contained misconceptions, for example to stop the colours or solvent from going over the top of the paper.

(a) (ii) Most students realised that the ink would dissolve in the solvent, and only a very small minority felt that drawing the line in pencil would enable it to be rubbed out if necessary. Some responses were not very clearly expressed, with a number of students giving answers allowed in the extra information in the mark scheme, rather than expressing their response in more scientific terms – ie solubility.

(b) (i) While the majority of students gained credit in this question , the most commonly seen incorrect responses were 7 and 3.

(b) (ii) Many students expressed their correct responses clearly, although some had difficulty explaining the reason for their answer. A minority of students felt that the food colouring was safe to eat because it contained two safe colours, or had not realised the purpose of the experiment.

(c) (i) Many students clearly knew the advantages of gas chromatography compared to paper chromatography, although a substantial minority gained 1 mark, and also gave responses such as reliable, precise, or reduces human error. Accurate and quicker were the most common responses gaining credit. Vague answers such as easier or better did not gain credit.

(c) (ii) Responses indicated some confusion between gas chromatography and the fragmentation of compounds which can occur during mass spectrometry/spectroscopy, exemplified by answers such as “separates it into its elements”.

(c) (iii) There was some evidence of confusion of M_r with mass or weight, and a few students’ responses indicated that they had no recollection of the purpose of mass spectroscopy.

Question 2 *(Standard Demand)*

(a) This question proved very discriminating, with students gaining marks across the whole range. The weakest students merely repeated information in the question. Other students were unable to recall any workable method to make potassium chloride, and also showed some fundamental misconceptions about the reaction of an acid with an alkali, for example, describing a method which would make a salt from an acid and insoluble base, and suggesting to filter off the excess reagent after neutralisation. The majority of students gave a method which would produce potassium chloride, but many omitted the addition of an indicator to determine the end point. Some students omitted a method to obtain crystals from the solution. Many of those who included the use of an indicator did not include either repeating the method without indicator, or the addition of charcoal to prevent the formation of coloured crystals. Some responses were superb, giving detailed, logical accounts of the method thereby demonstrating a clear understanding of the processes described. A small number of students appeared to think that in order to be sure that the crystals forming from their neutralised solution were potassium chloride, it was necessary to add some potassium chloride solution to the neutralised solution before evaporating the water. Students are encouraged to think through their ideas before writing to sequence them coherently. Some answers were poorly organised or had large quantities of writing crossed out. A substantial minority of responses contained information which was irrelevant, the quantity of which was taken into consideration for assessing the quality of communication. A surprisingly large number of students failed to use upper case letters at the beginning of each sentence. This combined with the frequent use of commas for full stops impacted on their quality of communication. Use of specialist terms was very variable, with most being able to name basic items of apparatus, but fewer referring to (teat) pipettes, or an appropriate container (eg evaporating basin or crystallising dish) for obtaining crystals. A small minority of students confused potassium hydroxide solution with potassium, or failed to understand the terms “solution” or “precipitate”.

(b) Many students gained this mark. The few incorrect responses appeared to give either the name of a different acid, or a randomly named element, eg potassium.

(c) (i) There were many correct responses. Those which were incorrect were split fairly evenly between suggesting that ammonium nitrate is a pesticide/herbicide, or used for neutralising soils. Students who gave two suggestions were not awarded the mark, even if one was correct.

(c) (ii) Most students gained 2 marks, one for ticking the middle box, and one for a reason. Very few students ticked the bottom box, but some accessed the 1 mark available for their reason for ticking the top box. There were also some very comprehensive answers gaining all 3 marks. The most commonly given reason was that this is based on opinion, but many students also recognised it as an ethical issue. A minority raised the financial implications, or stated that this cannot be found by experiment.

Question 3 *(Standard Demand)*

(a) Most students gave accurate and succinct definitions of exothermic. The minority who failed to gain credit often realised that energy transfer was involved, but in an incorrect direction. A very small minority of students failed to relate the term to any kind of energy transfer.

(b) (i) Although some students gave concise and accurate descriptions of the rate of the reaction, many students described how the volume of gas produced varied. This was accepted provided the volume of gas was related to time. Some students referred to the rate of reaction increasing at the start of the reaction. Others were inconsistent with their answers referring partly to rate, but confusing their description by referring to volume of gas as well. The weakest students simply described the shape of the graph. No credit was given for the simple statement ‘as the time increases the volume increases’. Students should be aware that this statement says nothing about the rate of the reaction.

(b) (ii) A high proportion of students gained all 3 marks. Some students gave the volume of gas as 20cm^3, but gained credit for a percentage yield of 80%. A small minority of students were unable to give a realistic response to either question. Some students calculated 16/25 = 0.6, then 0.6 x100 = 60%, presumably using the A_r of oxygen. 25/50 = 50% was a common error for (iii), regardless of the answer for (ii). Some students calculated 25/21 getting an answer greater than 100%. This should have alerted them to an error. Several students failed to convert to a percentage and gained one mark for 21/25 = 0.84.

(b) (iii) See above

(c) Although almost all responses focused on a description of collision theory, only the most able students gained credit for all 3 marking points. Most were aware of the increased energy or speed of the particles, but a lower proportion of students discussed both more frequent and more energetic collisions. Precise terminology is also important, for example writing not just 'move more' but 'move faster', and not just 'collide more' but 'collide more frequently'.

Question 4 ***(Standard / High Demand)***

(a) While a large majority of students gained credit, the most common error was 79. Other errors included 197, 79 and 39.

(b) Many students demonstrated a sound understanding of the process of ionisation. Students gaining only 1 of the 2 marks referred either to the gaining of 3 electrons, or omitted the number of electrons lost. A small minority of students referred to the wrong particle, thus gaining no credit.

(c) (i) It was heartening to see that approximately half of students successfully balanced the equation. Those gaining 1 mark often used O rather than O_2. A small minority of students introduced species other than oxygen on the left hand side, often gold, thus failing to gain credit, as they did not balance the equation.

(c) (ii) Many students wrote with understanding about the weak intermolecular forces in carbon dioxide. Students gaining 2 rather than 3 marks often did not explain that carbon dioxide comprises small molecules or has a simple molecular structure. A small minority of students either failed to mention intermolecular forces, or placed them in an incorrect context. A relatively small proportion of students referred to "weak bonds".

(d) A high proportion of students recalled at least one characteristic of catalysts, but a much smaller proportion could apply three ideas to the context of gold as a catalyst. Many students realised that use of gold as a catalyst reduces energy costs or speeds up the reaction, thus defraying the cost of the gold. Students also recalled that catalysts can be reused, but fewer students noted that only small quantities are needed or the specificity of catalysts. Some students referred to the low reactivity of gold as an advantage suggesting that it would not react. The weakest students recounted general properties of metals.

Question 5 ***(High Demand)***

(a) This question discriminated well. One of the most frequently seen errors was for students to fail to recognise that the A_r of aluminium (27) should have been multiplied by 2, thus calculating 27/102 x 100 = 26.5. One of the two marks was gained by this. Some students rounded down to 52 from 52.9, and so gained only 1 mark. Students should be encouraged to always show their working. When no or very little working was given along with an incorrect answer, the single mark for correct working could not be awarded.

(b) While some students were clearly familiar with the extraction of aluminium by electrolysis, others were unable to recall the factual detail needed to successfully answer parts of this question.

(b) (i) Only a small proportion of students were able to relate correctly the addition of cryolite to aluminium oxide to the lowering of the melting points, and thus to reduced energy need. Some students thought that cryolite is a catalyst, and others referred to the melting point of aluminium, or the boiling point of aluminium oxide.

(b) (ii) While a majority of students gained credit for $2O^{2-}$ on the left hand side of the equation, only a minority gained credit for $4e^{-}$ on the right hand side. Some students used oxygen atoms or molecules on the right hand side and a few incorporated other elements. A common error was to give $2e^{-}$ on the right hand side.

(b) (iii) A commonly seen misconception was that the positive electrode was used up in the formation of oxygen from oxide ions, often by giving electrons to the oxide ions. Weaker responses showed much confusion over the reactions occurring during the electrolysis.

Question 6 *(Standard / High Demand)*

(a) Some of the most able students were able to deduce or refer to the Chemistry Data Sheet to find the charges on the calcium and hydroxide ions. Other able students answered in terms of loss and gain of electrons. Some students referred to calcium gaining electrons from hydroxide or to covalent bonding and the sharing of electrons or to the balancing of an equation, rather than balancing charges.

(b) Responses which quantified the size of nanoparticles as 1-100 nm or a few hundred atoms, or which related to their high surface area to volume ratio, or different properties to “normal” size particles were credited. Approximately half of the students gained credit. Those who did not gain credit often gave imprecise responses such as very small or tiny.

(c) A large number of students gained 3 marks, and a substantial minority gained just the first marking point. Commonly seen errors included incorrect calculation of the M_r of $Ca(OH)_2$ (eg 72), or dividing 56/74 rather than 74/56. Another common error was to find the M_r of $Ca(OH)_2$ and multiply by 2. As always a variety of methods were employed by students, all of which were credited appropriately for their success.

Question 7 *(High Demand)*

(a) This question proved to be a good discriminator. The marking point relating to the intermolecular forces in graphite was gained by only the most able students, but that relating to layers sliding in graphite proved the most accessible. A small minority of students referred to incorrect bonding (eg intermolecular forces in diamond) or structure (simple molecular) in their answers. A small minority of the students also referred to crosslinking and thermosetting. Some students mistook softness for flexibility, referring to graphite being able to bend. Some students were content to explain why graphite was soft but then failed to go on to address why diamond was not soft, therefore not gaining the marks for that part of the mark scheme.

(b) Conductivity in graphite and diamond was well understood by many students, although some failed to refer to the delocalised electrons as charge or current carriers or as moving throughout the structure so did not gain the second marking point. A small minority of students were unable to relate conductivity to electron structure at all, and some referred to the need for graphite to be molten to conduct electricity.

Grade boundaries and cumulative percentage grades are available on the **Results statistics** page of the AQA website

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