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GCSE

Chemistry A

Twenty First Century Science Suite

General Certificate of Secondary Education **J634**

Examiners' Reports

January 2011

J634/R/11J

Oxford Cambridge and RSA Examinations

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Chemistry A (Twenty First Century) (J634)

EXAMINERS' REPORTS

Chief Examiner's Report

The number of candidates sitting these chemistry examination papers showed a substantial increase over the previous year, mainly at higher tier. Those who had good knowledge and understanding across the modules and a good grasp of the concepts involved performed well.

Once again the free response questions exposed weaknesses, but overall candidates were better prepared for these questions than previously. Many wrote their answers with more thought and structure. It was still observed, however, that a number of candidates wrote vague or irrelevant answers and did not address the question that was being asked. Weaker candidates again found difficulty in selecting relevant data and using it to present answers in a clear and logical manner. A significant number of candidates left some of the free response questions unanswered.

Performance in the objective questions was similar to previous sessions, and they discriminated well in both tiers and across all abilities. Few candidates left these questions unanswered, though a significant number made an incorrect number of choices from those offered with boxes to tick.

Overall many candidates were well prepared for the examination papers and showed a good grasp of the chemistry modules, whilst the knowledge and understanding of weaker candidates was more shallow and patchy. Some areas of the specification evidenced a lack of understanding for many candidates whereas other areas were grasped by the majority.

All papers discriminated across the appropriate ability ranges, affording more able candidates the opportunity to score highly whilst allowing weaker candidates to score a reasonable number of marks. It was clear, however, that a number of candidates had been inappropriately entered for the higher tier papers.

A321/01 – Twenty First Century Science Chemistry A (C1, C2, C3) Foundation Tier

General Comments

The performance generally on this paper was no different than that of last series.

There were no obvious issues in terms of the rubric, or in the time provided for the paper.

Candidates were most proficient at tackling the numerical questions (such as calculating the best estimate in question 5 (c)) but struggled to link sulfuric acid to acid rain and its effects in the final question – question 6.

It was obvious that candidates understood the significance of E numbers in question 1, and understood they must have passed safety tests.

Many candidates were familiar with hydrocarbons and polymers; correctly identifying polymerisation, but were less certain about explaining their properties.

A few candidates lost unnecessary marks by not choosing a response from given options; choosing one option instead of two (such as question 2 (c)) or in some cases making more choices than necessary (such as question 2 (a)).

Most candidates did not really understand the concept of sustainability and gave details about having trees for future generations, or even discussing plants producing oxygen instead of using ideas about the difference in energy use or different types of polluting chemicals.

Comments on Individual Questions

Q1 was answered well; many candidates knew the importance of preservatives and sweeteners. The first response caused a few problems with the most common misconception being that flavourings help mix ingredients together.

Candidates scored at least one mark for part (b), and many scored 3 full marks. Some candidates lost marks because they ticked in between boxes rather than making a clear indication of their responses.

Candidates were aware that some people believe there are health issues associated with E numbers, for section (c), but very few were able to explain that the benefits outweigh the risks (as required in this question).

Q2 demonstrated that most candidates are aware that there is some exchange of elements in various cycles, and that plants use nitrogen themselves during growth. Many candidates used key scientific terms in their responses to part (b) ie "respiration" and "photosynthesis." Weaker candidates misunderstood the question and stated vague responses because they had confused pollination with elements and therefore wrote about elements being "picked up on animals' fur."

Q3 parts (a) and (b) proved challenging for most candidates and very few achieved full marks, although many achieved at least a mark on section (a). Candidates mistakenly discussed the removal of trees and the loss of oxygen instead of referring directly to the differences in energy or pollution caused. Although cutting down trees as opposed to reusing materials could have provided a mark, the candidates failed to specify the difference in the jobs undertaken. Many candidates did, however, gain marks for referring to a difference in the chemicals used such as the bleaching stage, or because they explained new trees had to be debarked and chipped.

Few candidates achieved any marks for section (b) and frequently identified the screening and cleaning stage as being different, when the response required was "pulping, because they both require energy/ or beating to a pulp"

Many candidates achieved full marks in section (c), and were able to identify good reasons for recycling paper. Weaker candidates often ticked "waste paper can be burned in power stations..."

Candidates had a good understanding of hydrocarbons and most were able to select hydrogen and carbon as those found in hydrocarbons. They were also proficient at identifying polymerisation as the reaction which produces polymers. They were clear about the forces between molecules and many correctly identified the cross-links in molecules.

Candidates found it more difficult to correctly select statements explaining how to increase the melting point of polymers.

Q5 (a) proved challenging for most candidates; they were unable to select water as a product of combustion of hydrocarbons. They were much more successful at describing a correlation in part (b), although weaker candidates wrote random numbers into the spaces from the chart given.

Part (c) (i) and (ii) were answered well, and many candidates were able to correctly calculate the best estimate from given figures for an old engine. The most common incorrect responses were due not to incorrect calculations, but because the new engine figures had been used. Candidates also responded well to part (ii) and many were able to explain differences in carbon dioxide output.

Good candidates answered parts (c) (iii) and (iv) well, but many thought that fitting a catalytic convertor would reduce carbon dioxide emissions in part (iv).

Q6 proved challenging for many candidates, and there was a high omit rate in this question as a whole.

Many candidates incorrectly selected carbon particulates, or carbon monoxide as dissolving in rain water, instead of the required sulphur dioxide and carbon dioxide.

Few were able to explain that sulfur dioxide causes acid rain and lost marks because they gave direct effects such as "breathing problems." If carbon dioxide was stated as a response then few explained this was a greenhouse gas – some described it as "killing humans" or "suffocation" instead of global warming.

In section (c) candidates often lost marks because they drew six atoms joined together in a block instead of two separate carbon dioxide molecules. However, many good responses were given here and carbon dioxide was correctly represented using the atoms in the question.

A321/02 – Twenty First Century Science Chemistry A (C1, C2, C3) Higher Tier

General Comments

Once again the free response questions proved to be challenging to all but the most able candidates. Without the choice of statements to guide them, many candidates could not find direction and gave vague rambling answers that scored few marks.

As in previous sessions, more able candidates showed a broad knowledge and understanding of modules C1, C2 and C3. The most able could apply this knowledge and understanding successfully to the majority of questions on the paper, including the free response questions. Many weaker candidates, however, showed sound ability in some areas but weakness in others, whilst some showed a general weakness across all three modules.

The majority of candidates followed instructions carefully. However, a number of candidates failed to spot significant wording in the questions and as a result framed their answers incorrectly.

Most candidates could interpret data well, but many were confused when asked to show rather than calculate a value. Other areas of the specification which many candidates found particularly challenging included the drawing of molecule diagrams and the application of the precautionary principle. Some aspects of Life Cycle Assessments caused problems for many candidates, particularly the relevance of energy used or pollution caused to sustainability.

The overall spread of questions gave all candidates of appropriate ability for this paper the opportunity to demonstrate their expertise. Most questions discriminated well, giving a good spread of marks across the ability range. It was clear, however, that a small number of candidates would have gained a more fruitful experience from sitting the Foundation tier paper.

Comments on Individual Questions

Q1 Apart from (b) this question gave all candidates a chance to score some marks.

(a) This question discriminated very well across the ability range. More able candidates knew the purpose of all three types of food additive. Many of the weaker candidates were confused about the purpose of emulsifiers. The weakest also mixed up the purpose of preservatives, antioxidants and sweeteners, placing them in the wrong boxes in the table.

(b) This was a very challenging question. Many candidates could not frame an answer that suggested why the people mentioned in the question had chosen not to buy foods containing e-numbers. Answers that referred to these people lacking confidence in the safety tests were rarely seen. Many candidates gave long, rambling answers about the supposed harm caused by e-numbers. More able candidates generally gained two marks but very few gained all three. Many weaker candidates gained one mark for the idea of 'better safe than sorry'. About half of the candidates failed to score any marks.

(c) Most candidates clearly knew how the use of additives in foods is controlled. About two thirds of candidates gained both marks, with only a small number of the weakest failing to score any. The idea that scientists would decide on safe levels was a common incorrect response.

Q2 Most candidates performed very well in this question. Even the weakest gained a number of marks.

(a) More able candidates knew the three elements and gained both marks. Many gave carbon and oxygen but included nitrogen. Others became confused with the elements in NPK fertilisers.

(b) There were many possible ways to score the marks in this question, and a wide variety of answers were seen. The majority of candidates gained both marks, with only a minority failing to score. Common incorrect answers referred to the action of lightning or in general terms to the nitrogen cycle.

(c) A large majority of candidates correctly chose both correct statements, with only a very small number of the weakest candidates choosing both incorrectly.

Q3 This was a challenging question. Whilst most candidates gained some marks, only the more able scored well.

(a) Although told to use ideas from the diagram, many candidates failed to do so. Commonly the answers gave general comparisons between the sustainability of new and recycled paper which were not related to the information given. Many candidates incorrectly thought the new paper to be less sustainable because we would run out of trees. Only a small number of the most able realised that differences between the processes involved in making the two types of paper would result in differences in energy used or pollution created, leading to differences in the sustainability of the two processes.

(b) The question asked candidates to use the example of newspapers and books made from recycled paper. Most did not use this example and gained no marks from the question. Of those who did use the example, many could give a difference in the LCA of books and newspapers but few could relate this to the outcome. Only a very small number mentioned differences in the energy involved or pollution caused.

(c) A majority of candidates chose one of the correct statements, but only the more able chose both. The statements referring to water use and landfill were commonly chosen in error.

Q4 This question gave candidates across the ability range a chance to score marks, but discriminated well.

(a) For most candidates this question was a mystery. Many wrote the figures 0,1 and 2 in boxes, seemingly at random. The most able candidate clearly knew how to work out the answer and scored all three marks. Only a small number of candidates performed between these two extremes.

(b) In (i) most candidates were able to choose one of the correct statements, with many choosing both. A common error was to think that force B should be made stronger.

Answers gave a similar pattern in (ii), with all distracters chosen with equal frequency.

Q5 This question gave plenty of opportunity for candidates of all abilities to score marks.

(a) A very large majority of candidates could correctly describe the correlation, with only the weakest failing to score the mark. A common error was to relate the engine size to distance travelled.

(b) In (i) most candidates attempted to show a calculation of the mean.

(160+159+157+156)/4 = 632/4

More able discarded the outlier to gain both marks, but many included this in their calculation to gain only one mark. A significant minority seemed to be confused by the question asking them to show rather than calculate. Many of the weaker candidates did not attempt the question.

Only the more able could carry out the calculation in (ii). Generally these scored both marks whilst nearly all of the others failed to score.

(145-120) x 12 = 300

In (iii) the majority of candidates chose one correct statement, but only the more able chose both. A common error was to choose 'fitting catalytic converters'.

Q6 This was a challenging question, but gave even the weakest candidates the opportunity to score some marks.

(a) Most candidates chose sulfur dioxide. The more able then described the formation of acid rain and the harm that this could do eg to fish to gain both marks. A smaller number chose carbon dioxide and based their answer on greenhouse effect and global warming. Many weaker candidates misunderstood the reference to indirect harm and suggested that particulates affect lungs etc.

(b) Only the most able could draw correct diagrams of the three molecules, and fewer drew the correct number of these.

(c) In (i) a majority of candidates correctly named the compound as nitrogen monoxide. The most common incorrect answer was nitrogen oxide. Sulfur dioxide was also seen quite often.

Only the more able correctly answered air or atmosphere to gain the mark in (ii). Fuel, petrol and the engine were common incorrect answers.

In (iii) most candidates gave either water or oxygen as their answer, but very few gave both to gain the mark.

A322/01 – Twenty First Century Science Chemistry A (C4, C5, C6) Foundation Tier

General Comments

The free response questions in the paper enabled stronger candidates to show their grasp of the subject and their communication skills, but again they proved to be a problem area for weaker candidates. Many found difficulty in following the rubric of the question and then providing answers in a clear and logical manner.

Whilst more able candidates showed a sound knowledge and understanding at this level across modules C4, C5 and C6, others showed both a shallow and a patchy appreciation of even the basic concepts involved.

A number of the questions proved to be challenging to the more able candidates, but the overall mix of questions gave all candidates of appropriate ability for this component the opportunity to score plenty of marks. A number of questions clearly discriminated well, giving a good spread of mark totals across the ability range.

Some areas of the specification, for example titrations, clearly presented difficulty to many candidates. Other areas, such as the chemistry of Group 1 elements and the interpretation of molecular formulae, were well understood by the majority.

In several places a number of candidates chose an incorrect number of responses, probably following the rubric from the previous question. But only a few of the least able candidates left a significant number of questions unanswered.

Comments on Individual Questions

Q1 This question discriminated well whilst allowing even the weaker candidates to score some marks.

(a) Most candidates knew the first element in the table was sodium to gain one mark, but fewer gave the correct symbol for Caesium to gain the second mark. A common error was to give CS rather than Cs.

All but the very weakest candidates gave lithium, or less frequently francium, to gain the mark.

(b) In (i) only the more able correctly identified the gas as hydrogen.

Similarly in (ii) only the more able knew that an alkali is made in the reaction.

(c) A very large majority of candidates knew that caesium is more reactive than rubidium.

(d) Part (i) of this question discriminated very well across the ability range. All but the weakest candidates gained one mark, with the most able gaining all three. A variety of correct responses were seen. Marks were more often lost due to omission than incorrect suggestions.

In (ii) candidates needed to identify a hazard to Gemma and say how the screen prevented this causing harm to her. Most candidates managed to give one of these responses, but only the more able gave both.

Q2 This question discriminated very well across the whole ability range for this component.

(a) About half of the candidates correctly identified neutrons in (i). A variety of spellings were seen and accepted, but the mark was not given for neurons. The most common incorrect response was electrons.

In (ii) the majority of candidates correctly chose 2,4.

In (iii) about half of the candidates correctly chose 6.

(b) Only the most able candidates completed the lines correctly to gain this mark. Many were clearly confused by the question, since they drew multiple lines from each box.

Q3 Parts of this question were challenging, but other parts were accessible to weaker candidates.

(a) The question required both N_2 and O_2 to be ringed to gain the one mark. Most candidates ringed one or the other, together with one of the distracters. Only about half ringed both correct answers.

(b) A very large majority of candidates correctly chose N_2O_4.

(c) Only a minority of candidates gained a mark from this question, with a very small number gaining both. Many gave the exact opposites to the four correct responses.

(d) A majority of candidate gained both marks, and many more gained one. Others drew multiple lines from each box, losing both marks.

Q4 This question was very accessible to the majority of candidates.

(a) Most candidates gave the correct formula $C_2H_5NO_2$ to gain both marks, and many others gave the correct symbols with incorrect numbers to gain one mark. A common error for the weakest candidates was to include sulfur in the formula. A few candidates gave the correct formula for molecule B, which gained no marks.

(b) There were many possible correct answers that candidates could give to gain the marks in (i). More able gained both, but about half failed to score.

Again in (ii) there was a wide variety of possible correct answers. More able candidates gained both marks, with only the weakest unable to score.

(c) A majority of candidate gained at least one mark, with the more able gaining both. Proteins was the more commonly chosen correct answer. All of the distracters were chosen with about equal frequency.

Q5 This was a challenging question for candidates of all abilities.

(a) More than half of the candidates correctly chose the pH meter. Iodine and limewater were popular incorrect answers.

(b) In (i) very few candidates knew that sodium hydroxide is an alkali. All of the distracters were chosen frequently, but sodium chloride most often.

Weaker candidates had little idea of how to carry out a titration and gained no marks in (ii). The question discriminated well, with the more able gaining all three marks. Most candidates realised that vinegar should be added to the flask from the burette, and some knew that this should be done slowly. Only a few realised that this addition should stop when the indicator changes colour.

(c) Most candidates incorrectly chose canteen vinegar and so lost the mark in (i). Only a few of the more able correctly chose chip shop vinegar.

In (ii) most candidates correctly found the relative atomic masses for hydrogen and oxygen to gain one mark, but only the more able could then work out the relative formula mass of ethanoic acid as 60.

In (iii) only a tiny minority correctly realised that you would need the equation for the reaction, and the concentration of alkali used, to work out the concentration of acid in the vinegar. Many candidates ticked only one box.

Q6 A challenging question that still discriminated well across the ability range.

(a) Only a few of the most able candidates knew the salt to be copper sulfate, and so gain the mark in (i). A very wide variety of incorrect responses were seen, including sulfur dioxide, chloride, carbonate, carbonate salt, sulfuric salt, sulphuric hydroxide and neutralisation.

Only the most able chose both CO_2 and H_2O to gain the mark in (ii). Many others chose one of these, along with a distracter.

(b) A very large majority of candidate gained at least one mark for this question, with many gaining both. All of the distracters were seen frequently, and a significant number of candidates chose only one response.

A322/02 – Twenty First Century Science Chemistry A (C4, C5, C6) Higher Tier

General Comments

The paper was generally well attempted. Few gaps or unattempted questions were seen in the objective style parts of the paper. Candidates were better prepared for the longer answers than in 2010 and wrote their answers with more thought and structure. Where three marks were available, some candidates did not write enough points to access all three marks. Candidates should be advised that they should use the question mark allocation to help them to structure their answers.

Some candidates did not score highly on the paper. It should be noted that the higher tier paper is designed to differentiate between candidates at the higher grades. Candidates who aim at a C or D should be entered for the foundation tier paper, where they will have access to more of the questions.

Comments on Specific Questions

Question 1

(a) Most knew that the gas given off was hydrogen, but fewer gave the correct formula (H was a common incorrect answer). Some thought that rubidium hydroxide was a gas, perhaps using the answer to (ii) for help at an educated guess. Again, most knew that the alkali produced was rubidium hydroxide, gaining a mark in (ii).

(b) Many candidates knew that elements further down the group are more reactive, but not all connected this correctly to more energy being released. Some thought that the heat came from the air.

(c) **(i)** This long answer question was usually well answered, with many candidates gaining at least two of the available three marks. The difference in reactivity was well known. Fewer read the question carefully enough to realise that they were being asked what Gemma would *see*. Some did not use the mark allocation to make sure that they made three clear, separate points.

(c) **(ii)** Vague wording cost many marks here. Answers such as 'to keep her safe' or 'to protect her' were not given credit. The mark scheme looked for candidates to identify actual hazards in the reaction eg from the chemicals themselves (such as their corrosive nature) or from features of the reaction (such as the explosions or flames).

Question 2

(a) The idea of identifying elements from their spectra was well understood, with many candidates scoring both marks here.

(b) This part question was challenging, in that it was necessary to work out whether all four statements were true or false for two marks. Most candidates scored at least one of the available marks, again implying a good understanding of ions and their structure.

Question 3

(a) Some knew the formula for chlorine, but many did not realise that all of the information to complete the equation was given in the sentence above. Very few correctly used the state symbols, implying that they had not read the question properly.

(b) Most gained at least one mark, but few could identify two correct statements about the process. Some thought that magnesium atoms join to make molecules or give up electrons at the electrodes.

(c) Fewer candidates calculated the mass of chlorine correctly than calculated the mass of magnesium. The molecular nature of chlorine was the main stumbling block, with '35.5' being a commonly chosen incorrect answer. About half the candidates managed to answer both correctly, implying a good understanding of mass calculations.

(d) This question tested the candidates' understanding and ability to contrast the conduction of a current by a molten ionic compound compared to a metal. The commonest error was to state that electrons move in both. Many candidates who identified ions as having an important role in (i) nevertheless went on to say that the current was transferred through the molten compound by electron movement. In (ii) few clearly stated that the electrons in the metal structure are delocalised. This is an area of the specification that is not well understood.

Question 4

(a) Candidates found this question very straightforward, showing a good understanding of gases in the air.

(b) Most gained at least a single mark here, but less than half of the candidates correctly completed all four sentences.

(c) Candidates have a very good understanding of the links between formulae and 3-D representations of molecules. This question gave very high scores.

Question 5

(a) Many candidates did not identify the problem with using an indicator to test the pH of a coloured solution. Most thought that pH probes are 'always more accurate' than other methods.

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