OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry A

Twenty First Century Science Suite

General Certificate of Secondary Education **J634**

OCR Report to Centres

June 2012

Oxford Cambridge and RSA Examinations

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

OCR will not enter into any discussion or correspondence in connection with this report.

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OCR REPORT TO CENTRES

Overview

Candidates who had good knowledge and understanding across the seven modules and a good grasp of the concepts involved performed well. Some very good answers were seen. Weaker candidates were able to demonstrate a more patchy knowledge and understanding of the key areas of the modules, and often struggled to use their knowledge effectively to convey answers to questions.

Many candidates could interpret simple information provided in graphs, tables and diagrams correctly but only the more able could cope with more complex data. Only a small number of candidates could perform anything but the most simple of calculations correctly. It was also clear from candidates' answers that many had not experienced some of the practical procedures, for example titrations, that were an essential part of some questions.

Where two or three marks were available in a question it was common for candidates to express only one idea, hence scoring only one mark. Many candidates repeated part of the question stem, causing their answer to spread beyond the lines provided.

Most candidates attempted to answer the free response questions. In general, the more able gave coherent and concise answers but weaker candidates found difficulty in coping with the lack of detailed guidance provided. Many of the latter gave vague or indecisive responses that scored few marks. Often a lack of precision in candidates' use of English made the answer difficult to interpret.

Performance in the objective questions was similar to previous sessions. Few candidates left these questions unanswered though some failed to follow the rubric, particularly those relating to the number of ticks required and the linking of pieces of information. Overall these questions gave all candidates an opportunity to show their knowledge and understanding and discriminated well in both tiers and across all abilities.

Of the seven modules, performance was least sound in C7. Many candidates showed little knowledge of the extension material and only a weak grasp of the additional concepts involved. As a consequence they struggled to answer questions set on this part of the specification.

All papers discriminated well across their target ability ranges, affording more able candidates the opportunity to score highly whilst allowing weaker candidates to score a reasonable number of marks. It was again clear, however, that a significant 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 candidates were able to access the examination questions well with very few omissions.

Candidates did not always display their working for calculations, though the use of appropriate conventions with chemical symbols was generally sound.

Candidates were able to interpret trends from data displayed on graphs, and although they struggled with the more demanding calculations, they were able to draw valid conclusions from the results they gained.

The majority of candidates demonstrated a secure understanding of the structure of hydrocarbons, but their knowledge of the underlying principles of digestion was not very clear.

Comments on Individual Questions

1 (a) For the first of the four answers most candidates correctly identified argon as the gas. Whilst candidates generally scored quite well on the other parts of the question this is where most of the problems occurred. For instance, the formula for carbon dioxide was sometimes written with a lower case 'o' and/or superscript '2'. A pleasing number of candidates correctly identified the percentage of nitrogen in the air and the correct symbol to use for the oxygen atoms. Where candidates ran into problems with the oxygen diagram they frequently indicated only one oxygen atom, or sometimes two oxygen atoms that were not bonded together.

(b) A lot of candidates correctly identified 'photosynthesis' as a correct answer, but many thought that 'respiration' was also correct. There were a lot of answers that were a little too vague, such as 'plants take it in', or even just 'rain', without any explanation relating to carbon dioxide dissolving.

(c) Many candidates correctly identified carbon monoxide as an answer, with the oxides of nitrogen being seen only rarely. Of the answers that did not gain a mark sulfur dioxide and carbon dioxide were the ones most frequently seen (these gases were mentioned in the question).

2 (a) In general candidates demonstrated that they were able to describe the correlation correctly.

(b) Many candidates had little trouble here. Some candidates who got the best estimate wrong picked up a point for showing their working, but this was quite rare. A common error was when candidates merely summed the pH values and so gave an answer of '26'.

(c) The majority of candidates only gave one answer for this question and so only got one mark. Answers relating to either 'traffic' or 'wind activity' were common.

3 **(a)** This question was one where many candidates scored just one out of the two marks available. Common answers showed that the candidates had correctly identified glass bottles as the problem due to the high levels of sulfur dioxide and/or nitrogen oxide pollutants. However, many candidates failed to explicitly make the link between these gases and the causes of acid rain.

A large number of incorrect answers were due to candidates missing the sense of the question. In this case rather than saying that 'glass bottles caused more acid rain' the candidates would write that 'sulfur dioxide caused acid rain' and not indicate which bottle they were talking about.

(b) **(i)** Some candidates missed the point of the calculation and either supplied an answer without any working at all, or carried out additions of the two numbers involved, such as 4.7 + 2.2.

(iii) Candidates generally performed well on this question, identifying the most sustainable bottle based on their calculations and justifying their answers.

(iv) The candidates made a clear link with answers relating to energy. Apart from the two correct responses, a popular choice was the 'energy input for making the material'.

4 **(a)** This was generally handled well. The main problem being that when candidates made the wrong choice it was often because they thought that milk is made up of one chemical.

(b) Candidates performed very well on this question. Any problems were caused by doubts about the elements contained in hydrocarbons.

5 **(a)** Candidates were often drawn to the option 'it is not possible for anything to be completely safe'. Another popular incorrect choice was that 'metaldehyde helps to protect crops' which is true, but does not address the question.

(b) Candidates tended to correctly identify that metaldehyde was beneficial in that it protected crops. What was less common was an appreciation that the benefits outweighed the risks, and that the risks were minor. A lot of answers gave the impression that the risk was significant but the benefits so great as to outweigh them.

(c) **(i)** This was generally answered well.

(ii) Candidates found this question quite difficult. Many answers involved the use of pesticides, and a great number relied on covering fields with salt.

6 **(a)** Candidates tended not to go into the underlying science for this question. A lot of answers rephrased parts of the question and so were related to 'digesting' and 'breaking down'. A lot of candidates referred to food being easier to swallow if it was chewed, and with reduced choking risks. When candidates did score here it was usually through discussion of 'absorption' or nutrients getting into the 'blood stream'.

(b) Candidates found this question quite searching. There were strong signs of confusion about the digestion of proteins. For example, a common answer in the first box was 'carbohydrates'. Further confusion over terms was evident in the answers to the second box. This contained a phrase that was often completed as 'excess broken down in the urea'.

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

General Comments

With the advent of the new specification paper, A171/02, the number of candidates entered for this paper was significantly reduced, but there did appear to be an increase in the number of more able candidates entered.

As in previous years, weaker candidates struggled with the free response questions, with only the more able constructing answers that demonstrated their knowledge and understanding effectively. Weaker candidates failed to cope with the lack of statements to guide them and gave vague, or indecisive, responses that scored few marks.

The more able candidates showed a good level of knowledge and understanding across all three modules C1, C2 and C3. The most able candidates demonstrated their knowledge and understanding across the whole of the paper and were able to give accurate answers to the free response questions. Weaker candidates were able to demonstrate some general knowledge and understanding of the key areas of all three modules, but often struggled with language to convey their knowledge effectively in the free response questions.

The majority of candidates followed the instructions given for each question carefully. Most could handle simple data sets effectively, but weaker candidates struggled with more complex tasks. Other areas of the specification that candidates struggled with included conservation of atoms, cause and correlation, and the ALARA principal as applied to pesticide residues.

The overall spread of questions gave candidates the opportunity to demonstrate their knowledge and understanding across all three modules. It was clear however, that a small number of students would have been better served by sitting the Foundation tier paper.

Comments on Individual Questions

1 (a) This question discriminated well; able candidates scored all 4 marks, with weaker candidates often only scoring the marks for nitrogen and/or oxygen. Common errors included superscript 2 on CO_2, and N_2, and atoms not touching in the molecule diagrams or the wrong percentage given for oxygen.

(b) More able candidates scored both marks, weaker candidates often scored zero or left the question blank.

(c) Many candidates scored two marks, common errors included giving two nitrogen compounds, or giving carbon dioxide as a pollutant even though this was named in the stem of the question.

2 (a) Most candidates attempted this question, many being successful. Common errors included a simple statement of “there is a negative correlation...”, and answers of the type “as the concentration increases so does the pH of the rain water”, showing candidates had failed to appreciate the data provided on the axes of the graph.

(b) **(i)** Most candidates calculated an average value, but only the more able candidates omitted the outlier at 3.4 and so correctly calculated the average as 5.2. Other common errors included obtaining a median value of 5.1 which scored zero.

(b) **(ii)** Most candidates scored one mark for an answer related to different numbers of motor vehicles, or for change in the wind direction, but not many candidates scored two marks.

3 Apart from part (b) most candidates answered this question well.

(a) The majority of candidates scored this mark for ticks in boxes two and four.

(b) Few candidates scored both marks. Most could correctly state that being obese **increased the chance** that you could develop type 2 diabetes. Only the most able also correctly stated that being obese did NOT mean that you were certain to become diabetic.

(c) The majority of candidates scored two marks for ticks in boxes two and four.

(d) The majority of candidates scored one mark for a tick in box four. More able candidates also scored for ticking box one.

4 Poor interpretation of the data provided cost candidates marks in this question.

(a) Many candidates simply added up the total for both bottle types and commented on the total level of pollutants. Some candidates failed to demonstrate any understanding of the environmental impact of the gases released. Where candidates did comment correctly on the data about the pollutants being released, they failed to link it to a suitable environmental concern and consequently only scored one mark. More able candidates did score two marks.

(b) **(i)** Many candidates correctly calculated the value for polythene as 34.5MJ and scored one mark, however only the more able scored the mark for calculating the correct value for glass as 19.7MJ. The most common incorrect value was 48.5MJ [(7.2 + 2.5) x 5]. However, where candidates had calculated a value for the glass they did then score a second mark for carrying out a subtraction that gave an answer close to the expected value of 15MJ.

(b) **(ii)** This linked to (b)(i) and many candidates failed to score more than one mark for not mentioning that **energy is saved** by recycling/re-using the glass bottles. The most common errors were for failing to use the terms in bold from the mark scheme.

(b) **(iii)** The majority of candidates scored one mark for a tick in box six. More able candidates also scored for ticking box four. The most common incorrect response was a tick in box two rather than box four.

5 **(a)** The majority of candidates scored two marks for a tick in box two and box five. Only the weakest candidates failed to score any marks here.

(b) Most candidates scored two marks for ticks in boxes one and five, only the most able scored the third mark for a tick in box four with the most common error being a tick in box three.

6 **(a)** The majority of candidates scored two marks for a tick in box two and in box five.

(b) This question was a good discriminator at the top end of the ability range. Weaker candidates tended to score only one mark for the idea of the benefit outweighing the risk (of using metaldehyde). More able candidates were also able to identify a suitable benefit eg higher yield of crops/increased profit/crops not being damaged by slugs etc. Only the more able candidates also recognised that the risk from water pollution was low because the levels entering the water were low.

(c) The majority of candidates scored at least one mark in this question, only the weakest candidates failed to score a second mark also.

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

General Comments

The paper was challenging but no candidates appear to have been disadvantaged by language or cultural issues. A number of candidates found the examination difficult and a few of these failed to respond to most of the questions. Apart from these, most candidates attempted all of the questions, so there was no indication of time pressure or other constraints. The performance of the candidates was similar to previous sessions.

Comments on Individual Questions

1 Very few candidates were able to address both similarities and differences from within the table of properties in part (a). It was expected that candidates would be able to identify trends within the group rather than suggesting that the boiling point was always higher than the melting point. In part (aii), many candidates could identify density as not following a trend, but did not explain their choice in enough detail. Most candidates gave the correct formula in part (b), although a few lost marks by inappropriate capitalisation.

2 The majority of candidates could give the correct answer to part (a) but a surprising number were unable to complete the electronic structure diagram in part (b). Names of the subatomic particles in the nucleus was well known by high achieving candidates, but weaker candidates gave answers including names of elements, compounds and even words which had no relevance to chemistry.

3 The state and colour of the halogen elements were not well known and very few candidates scored both marks in part (a). Even more unsatisfactory was the way in which many candidates failed to take advantage of part (bi) which should have been a very accessible question. Symbol equations were only credited when completely correct (including balancing). Candidates also found the final part of this question difficult. A number correctly labelled the hazard symbols – but applied a random one to chlorine.

4 This question required candidates to relate their knowledge of the atmosphere with understanding of elements, compounds and bonding. Most foundation candidates found this challenging, with good candidates often asserting that all the gases in the atmosphere are elements, even though carbon dioxide had been mentioned earlier in the question and was then the focus of the next question.

5 Weak candidates attempted part (a) by using the words on the diagram, which generally yielded just one mark. Very few achieved full marks, usually missing out the idea that there would be a balance between carbon dioxide going into and out of the atmosphere. Although requiring quite a lot of reading, more than half of the candidates got a mark on part (b).

6 Although candidates did not have to describe the process in words, the use of objective items demonstrated quite clearly that candidates did not have the level of understanding of the processes of electrolysis which should be routine at this level. The final part indicated that candidates were more secure in their knowledge of the properties and uses of aluminium.

7 Candidates found the equation in part (a) challenging. Those who made a good attempt often referred to hydrochloric acid as hydrogen chloride. Most candidates seemed unaware that water would be the missing product, often expecting hydrogen gas. Part (b) was also not well understood – with most candidates apparently choosing at random – and frequently only choosing one option. Part (c) was an opportunity for candidates to describe their "hands on" practical experience and was much better done than the earlier sections. Most candidates were able to achieve half marks or better. However, a disappointing number of candidates did not seem able to sort the stages into a sensible order, often heating solid copper carbonate in the hope of getting crystals of copper chloride. There is no substitute for real laboratory experience in learning chemistry.

8 Questions on reaction rates have previously produced generally good answers and this was no exception. Most candidates achieved more than 50% on the question with high scores common. Good candidates usually knew the state symbols in part (a) and zinc sulfate was correctly identified in part (b). Although the wording of the choices in part (c) was unambiguous, candidates often missed the "larger surface area" response, preferring either lower mass or larger pieces. The understanding of the graph in part (d) was better for the start of the experiment than the end. Many believed that at five minutes, the reaction was at its fastest or that the gas was being given off at a constant speed.

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

General Comments

Although the majority of candidates entered for this paper were well matched to it, a significant minority were not. Any candidate whose grade is very unlikely to be above C would have a much nicer examination experience by taking the Foundation Tier paper instead. They would know the correct answers to more questions, not be faced with questions that they couldn't answer (or had to guess at), and earn the same grade.

It was good to see that the vast majority of candidates felt able to have a go at nearly all of the questions, even if they didn't get them right. There was no evidence that candidates ran out of time.

A significant number of candidates were unable to describe the procedure for titration in Q8(a), avoiding the question completely. This implies that they had never done one themselves, even though this aspect of the specification is not confined to just the Higher Tier paper. Centres must realise that if an exam has no optional questions, it is important that candidates are exposed to the entire content of the specification.

Candidates still have difficulty in earning high marks for the free-response questions, usually because they aren't precise enough. This was particularly acute in Q5 where many candidates made extensive use of the word *it*, making it impossible for their examiners to determine if they were talking about ethanol, sugar cane, carbon or carbon dioxide. Centres who do not give candidates enough practice at acquiring the skill of precise writing are putting them at a disadvantage.

Comments on Individual Questions

Q1 This first question was about the properties of alkali metals. The first two parts also appeared on the Foundation Tier paper, so were intended to be easier than most of the rest of the paper. However, the free-response nature of the first two questions appeared to hamper candidates, many of whom were unable to express themselves clearly. The majority of candidates earned two marks for mentioning the trend in melting and boiling points, but few earned the third mark for the similarity of the formulae for hydroxides. Many candidates simply said that the elements formed hydroxides, which was not enough. Similarly, although many candidates spotted that density did not have a trend, few quoted evidence from the table to support their assertion. Few candidates failed to earn less than one mark for the multiple choice question about the properties of caesium, and many earned both marks. It was disappointing to find many candidates losing the mark for the formula of caesium hydroxide by being careless over use of capital and lower case letters.

Q2 Many weak candidates struggled to earn marks on this question about atomic structure, although strong candidates often earned full marks. In particular, only a minority of candidates could correctly state the charge on the ion – candidates had to mention the magnitude (1) as well as the sign (+) to get the mark.

Q3 Most candidates found this question about halogens quite challenging. Many of them simply did not know the colours or states of the three elements in the table, and only the strongest candidates were able to earn even one mark for the symbol equation for the formation of sodium chloride from sodium and chlorine. Those few candidates who realised that chlorine is a diatomic molecule tended to have no difficulty in earning the second mark for balancing the equation.

Q4 The vast majority of candidates had no trouble correctly linking each gas in air to its molecular structure and relative atomic mass. Although most candidates could correctly identify one correct statement about air, only about half could identify both. The same was true of the final part of the question about covalent bonds.

Q5 This question was very poorly answered by most candidates. They were asked to use the diagram to show that ethanol is a carbon neutral fuel, so the many candidates who did not refer to the diagram at all, but simply wrote in general terms about the carbon cycle earned no marks. Weak candidates who did discuss the diagram tended to write about every aspect of it, providing labyrinthine explanations which were difficult to follow. In particular, candidates who made extensive use of the term 'it' made it difficult for the reader to decide if they were talking about ethanol, sugar cane or carbon dioxide. Only a few strong candidates identified the three key processes (combustion, photosynthesis and fermentation) and discussed the passage of carbon through the cycle along these paths. To earn full marks, they had to do little more than convert the important loop in the diagram from pictorial form to a story.

Q6 As expected, only the strongest candidates were able to earn full marks for the calculation. A significant minority of weak candidates declined to have a go at all, however, it was good to find that so many candidates were able to calculate the correct answer for a reaction that was far from straightforward. Just less than half the candidates could identify the correct reason why aluminium oxide could not be extracted by carbon – the high melting point of the oxide being a common wrong answer.

Q7 The first two parts of this question also appeared on the Foundation Tier paper, so strong candidates found them easy. A disappointing number of weak candidates wrote hydrogen chloride instead of hydrochloric acid, and poor attention to subscripts and capitals led to many candidates losing the mark for the symbol H_2O. Just under half of the candidates could identify the correct pair of compounds for the second part. The rest of the question was considerably harder, with only the strongest candidates being able to calculate the yield and percentage yield.

Q8 This last question was about titrations. It was good to find that most strong candidates were able to write a complete and comprehensive account of performing a titration. Weak candidates often wrote about something else altogether, implying that they had never done a titration as part of the course. Most candidates had no difficulty in spotting the pattern in the results table and completing it. The ionic equation defeated many weak candidates, seemingly filling the boxes at random, but it was good to find that the vast majority of strong candidates earned full marks.

A323/01 – Twenty First Century Science Chemistry A (Ideas in Context plus C7) Foundation Tier

General Comments

Questions about the insert article “Do plasticizers make boys more feminine?” were generally answered well. Candidates were clear about the possible issues surrounding the use of plasticizers and expressed their ideas clearly.

Candidates found it difficult, however, to explain why some scientists may have different ideas about the same data. The tendency was to repeat the stem of the question with what the scientists thought, but not the reasons for the differences in opinion.

Ideas about reversible reactions were expressed well and good understanding was demonstrated; the use of the word “equilibrium” was in the correct context with some candidates, although few candidates were able to explain that in an equilibrium there will be chemicals from both the left hand side and right hand side of the equation.

Many candidates successfully interpreted the trace from a sample in question 3. They understood the principles of chromatography and some knew that there may be other peaks due to impurities. However, descriptions of how the chromatography was used to separate a mixture demonstrated misconceptions in this procedure; there had clearly been practical lessons on paper chromatography which had then confused many candidates. Discussion was frequently about the separation on paper using water as a solvent. To improve the quality of written responses here, Centres would do well to emphasise the differences between different types of chromatography. The best responses were those that simply explained that the sample was able to move with the carrier gas (the mobile phase) and that this then moved through the stationary phase (which could be a solid or liquid) and the components moved at different speeds.

Candidates struggled with extended questions such as Q3(c) and Q4(a)(iii). Practice is required so that candidates are able to sequence their responses in a coherent way. For example, in Q4(a)(iii) there was some understanding of a method of titration, but marks were lost because the sequence of method was confused or poorly explained. Those responses that achieved the full three marks were those that explained an indicator was used with the aspirin mixture in a conical flask; sodium hydroxide was added drop by drop using a burette until a colour change was observed.

In Q5(b)(ii) many candidates misread the rubric and described the shape of the graph without explanation. There were many analogies used such as “it is like a mountain,” but the question required the increase in rate up to a maximum of 34^{o}C, followed by a decrease – then explanation of denatured enzymes. Many candidates described the volume of carbon dioxide released here instead of the rate at which the gas is released. In addition, the optimum temperature was often incorrect due to the candidates misreading the scale on the graph.

Most candidates attempted all questions, even those where they were struggling to understand the concepts involved.

Comments on Individual Questions

Question 1

1 (a) This was answered well; most candidates achieved the full two marks.

1 (b) (i) The vast majority of candidates achieved the full two marks and clearly had a good grasp of the useful properties of PVC when plasticizers are added.

1 (b) (ii) Many candidates did achieve full marks for this question. Those that didn't often gave the correct method of entry into the body (contaminated food/eaten/breathed in) but failed to state that the plasticizers diffuse out of the products that contain them.

1 (c) (i) Many candidates achieved two marks for explaining the effects on boys according to the article (less likely to play with traditional boys' toys/ less likely to join in with rough and tumble games). Most common incorrect responses were where the candidate had misinterpreted the article due to the headline and written that "boys would become more female" or "boys played with girls' toys" which could not be deduced from the information.

1 (c) (i) This question was answered less well than the earlier questions; most candidates gave incorrect responses such as "test girls" which does not relate to the article. The questions required responses such as using a control group or repeating the testing with a larger sample size.

1 (d) This was answered well and the vast majority of candidates gained the full two marks for this question; the answers were good and often included correct scientific terms such as "biodegradability" and "low toxicity".

1 (e) Few candidates gained marks on this question. Candidates found it difficult to explain why some scientists may have different ideas about the same data. The tendency was to repeat the stem of the question with what the scientists thought, but not the reasons for the differences in opinion. This question required ideas such as bias; one may work for a phthalate company and have different views; data can be interpreted differently by different people with different opinions, or some people have already formed ideas which can be difficult to change.

Question 2

2 (a) Most candidates understood what the symbol meant and stated "reversible reaction." In some cases, the word "equilibrium" was also used for the second mark. Few were able to explain that there would be some ethene and steam and ethanol present at all times.

2 (b) About half of all candidates selected the correct response as distillation. The biggest distracter proved to be filtration.

2 (c) Very few candidates achieved any marks on this question. A few were able to state that ethene is recycled, but even fewer gave the correct response to achieve a second mark; the un-reacted ethene is reacted again with steam to produce more ethanol.

2 (d) (i) There were three marks available for this question and most candidates achieved at least one mark. Marks were often lost because it was not clear where the candidates meant to put their chemicals. To achieve the full three marks, candidates needed to ensure that ethene and steam were directly above (not below) the first line, for example, and not to the right of the arrow pointing down, otherwise it was not obvious to examiners what they meant.

2 (d) (ii) Here candidates tended to either achieve the full two marks or no marks at all. Where there were no marks achieved, it was clear that there was some understanding about what happens in reactions to bonds, but they had forgotten whether it was "broken" or "made" that came first.

2 (e) and **(f)** Hardly any candidates achieved any marks at all for these questions. Ideas about activation energy were very confused; frequently the responses for 2(e) stated that "heating gives more activation energy" and candidates had therefore not understood the ideas about reactions in terms of energy. This question, for two marks, required that candidates state that there is a minimum amount of energy required for a reaction to take place (activation energy) and there are more molecules with higher energy at higher temperatures so more molecules have reached this activation energy. In 2(f) the correct response was that a catalyst lowers activation energy (1 mark) and provides an alternative route for the reaction to take place (2nd mark).

Question 3

Although many candidates were able to achieve marks across question 3, Q3(a)(i) and (ii) proved challenging and few were able to explain successfully what was meant by retention time. The most common incorrect response was "the time taken for the reaction to take place." For Q3(a)(ii) the correct response required was for candidates to explain that this enables the identification of methyl esters (in other samples).

3 (a) (iii) The majority of candidates answered well here and explained the correct relationship between the number of carbon atoms and the retention times using the table.

3 (b) (i) This was also answered well. Candidates achieved full marks for the correct identification of the three unknown methyl esters.

3 (b) (ii) This question required that there may be other impurities, but common mistakes here were responses which gave other methyl esters as being present, even though in the rubric it states "there are only three methyl esters."

3 (b) (iii) Many candidates correctly identified "myristic" as the methyl ester at the lowest concentration.

3 (c) This was answered poorly. Few candidates were able to explain how the gas chromatography worked and often discussed paper chromatography. They had clearly experienced using this in practical lessons, but to improve responses in the future, the differences between the different types of chromatography could be more explicit when teaching this topic.

3 (d) Candidates answered this well, and were able to explain why esters are used in perfumes. In the next question, 3(d)(ii) there were many correct responses of different uses, but marks were lost in some cases as candidates stated the same use as the previous question (such as air fresheners).

Question 4

Although it was clear from many responses throughout this question that candidates had undertaken titration investigations in lessons, the whole of Q4 proved challenging. Virtually no candidates achieved any marks for (a)(i). This required 100cm^3 of stock solution in 900cm^3 water.

4 (a) (ii) Most candidates selected the correct letter, D.

4 (a) (iii) Responses here were confused and out of sequence. Frequently candidates stated that the burette was used to deliver indicator at the end, and weaker candidates failed to mention colour change or to name the chemicals they were using. Marks were often lost because it wasn't clear which chemical was being added. Those responses that achieved the full three marks were those that explained an indicator was used with the aspirin mixture in a conical flask (1 mark); sodium hydroxide was added drop by drop using a burette (1 mark) until a colour change was observed (1 mark).

4 (b) (i) Most candidates calculated the correct response of 40 (the requirement was to demonstrate clearly in the question that they had added the correct numbers for each element) and were able to select the correct masses to use in the question.

4 (b) (ii) A very small number of candidates achieved any marks in this question. Frequently, the values in the question used were randomly chosen from previous questions rather than the 27.4cm^3 given in the question itself.

Question 5

Less than half of candidates were able to write a correct word equation for Q5(a). Practice is still required here to interpret information given in the question.

5 (b) (i) There was little success for the majority of candidates in selecting the correct value from the graph of 34^{o}C.The scale was incorrectly interpreted by many, and in other cases, candidates merely chose the end of the line graph (44^{o}C) as the correct response.

5 (b) (ii) Many candidates achieved at least one mark, but few achieved two or three. Explanation was not given as demanded by the question. Frequently, candidates gave vague references to the shape being like a hill or "peaking" but without explaining this in terms of increasing rate, up to the optimum of 34^{o}C, and then a decreasing rate. The best responses were those that explained this in terms of denaturing enzymes in yeast or destroying the active site in yeast.

A323/02 – Twenty First Century Science Chemistry A (Ideas in Context plus C7) Higher Tier

General Comments

The majority of candidates could identify and extract ideas and information from the article relevant to simple questions and reproduce these in their answers. Most of the more able candidates were also able to use their knowledge and understanding to process information from the article and use it to formulate an answer to more complex questions. However, for many of the weaker candidates anything beyond finding and copying a relevant part of the article was too difficult. Many candidates could interpret simple information provided in graphs, tables and diagrams correctly, but only the more able could cope with more complex data.

A number of candidates successfully demonstrated sound knowledge and understanding of the extension material and the ability to use their skills in a variety of situations. For many, however, knowledge and understanding was patchy.

This component is intended to assess candidates across the middle and upper levels of ability. Whilst many candidates could perform adequately in the more modest areas of this range, very few could consistently answer questions set nearer to the top end. It is expected that some questions will be answered well by only the more able candidates, for example those involving concepts such as dynamic equilibrium, however there was poor performance by many candidates in many of the basic areas, such as units, forces, energy, solutions and equations. Only a small number of candidates could perform anything but the most simple of calculations correctly. Many candidates would have performed far better on the Foundation paper. However, few candidates left many questions blank. There was no evidence that candidates had insufficient time to complete the paper.

Comments on Individual Questions

Q1 Where information had to be extracted from the article most candidates did well, but only the more able could use their own knowledge and understanding to answer more involved questions.

(a) Most candidates extracted information from the article to answer this question correctly. A common error was to mention food but not say how the plasticizers got there. Only the weakest gave answers that were too vague for either mark.

(b) The majority of candidates gained one mark and the more able both marks. Common correct answers referred to the small test group, the unreliability of the mothers' opinions and the influence of other factors such as female siblings. Weaker candidates gave vague references to lack of evidence which did not gain credit.

(c) Most candidates simply described the opinions of the two scientists, gaining no marks. More able candidates made suggestions based on ideas of data interpretation and bias to gain one or both marks.

(d) The idea of 'better safe than sorry' was known to many, but fewer could explain the precautionary principle on the basis of being unsure of the danger and therefore banning just in case or until the case is proven.

(e) Despite the stem of this question indicating that ideas about forces and energy should be used, many answers omitted one or both of these terms. Those who scored just one mark often mentioned that plasticizer molecules get between or push apart polymer chains. More able candidates went on to mention that this weakens the forces of attraction between these chains. Only the most able realised that weaker forces mean that less energy is needed to separate or slide the chains.

(f) Many candidates extracted from the article the idea that plasticizers diffuse to the surface and out of the PVC. Very few went on to explain that without plasticizers the polymer chains were no longer modified and became less durable. Some weaker candidates thought that PVC diffused.

Q2 Many candidates had difficulty interpreting the given information correctly. Few candidates could correctly draw an energy level diagram.

(a) In (i) most candidates incorrectly thought that the mixture needs to be heated to distil off each component. Only the most able realised that the mixture is at 300°C when leaving the reaction chamber and therefore needs to be cooled in order to separate water and ethanol as liquids and leave ethene as a gas. Some candidates gained one mark for realising that the boiling point of ethene is lower than those of water and ethanol. In (ii) only the more able interpreted the information to mean that there were no other products than ethanol in the reaction. A common error was simply to describe the conservation of atoms in reactions. More candidates gained the mark in (iii), usually for suggesting that some of the products was lost or that there would be other products from the reaction. A few correctly pointed out that the reaction is reversible, so some of the product would go back to reactants.

(b) More able candidates knew that forward and backward reactions occur at the same rate, though fewer stated that they take place at the same time. Some simply pointed out that the reaction occurs in both directions, which did not gain credit. Weaker candidates gave vague answers that often made little sense.

(c) Most candidates made a sensible attempt at drawing this diagram, with only the least able having no idea of what to do. The more able gained two marks but only a few drew a totally correct diagram for all three marks. Common errors were to make the reactants energy level line lower than the products line or to label them the wrong way round. Only the most able correctly drew and labelled the energy given out as the difference between the two lines.

(d) Common correct ideas were that a reaction needs a minimum amount of energy to react or to break bonds and that there is more energy at a higher temperature. Many candidates presented one of these ideas but only the most able gave both. Weaker candidates thought that the activation energy was less at higher temperature.

(e) Most candidates gained at least one mark, usually for the idea of the catalysed reaction having lower activation energy. More able candidates also knew that the reaction followed a different route. Many weaker candidates gave vague answers based on particle movement that gained no credit. A significant number incorrectly thought that the catalyst gave the reactants more energy.

Q3 Interpretation of information from the trace and table was good for all but the weakest candidates.

(a) In (i) a significant minority of candidates realised the significance of using a standard mixture of methyl esters as a reference to identify those in the bio-ethanol. Many weaker candidates thought it gave an idea of when the chromatography would be complete. In (ii) all but the very weakest candidates could describe the correlation correctly.

(b) Most candidates correctly identified the three methyl esters in (i), suggested that there were impurities or other chemicals present in (ii) and correctly identified myristic as the methyl ester with least concentration in (iii) to gain all three marks. Only the weakest candidates made errors in the identification of methyl esters from the gas chromatography trace.

(c) Few candidates demonstrated an understanding of gas chromatography and many repeated information from the stem. Many realised that the different retention times of the methyl esters had something to do with the equilibrium between the mobile and stationary phases, but could not put together a coherent answer. More able candidates could explain the relationship of each methyl ester with the phases in terms of attraction, equilibrium position or time spent in each phase and some of these could then explain why some of the esters travelled quicker than others. Few answers were succinct. Few candidates mentioned that the mobile phase carries the sample through the stationary phase. Overall this question was an excellent discriminator for better candidates. Weaker candidates often gave either very short or long rambling answers, with little relevance. Some described paper chromatography.

Q4 The weakness of many candidates when given a question involving numbers was demonstrated by these questions.

(a) Very few candidates had any sensible idea of how to make up the solution in part (i). A wide variety of incorrect answers were seen, with many candidates clearly not understanding the difference between units for volume and those for concentration. Only a tiny proportion of candidates realised that 100 cm^3 (or 0.1 dm^3) of stock solution needed to be made up to 1000 cm^3 (or 1.0 dm^3) of solution by adding water. In (ii) most realised that the indicator changed colour but fewer could explain the significance of this in the titration procedure.

(b) In (i) all but the weakest candidates extracted the correct relative atomic masses from the Periodic Table and showed that they added to 40. A few candidates used the atomic numbers instead. In (ii) only a small number of the most able had any clear idea of how to begin this calculation.

40g sodium hydroxide reacts with 180g aspirin, so 10 000cm^3 NaOH solution reacts with 180g aspirin
27.4 cm^3 reacts with (27.4 x 180)/10 000 = 0.493 g aspirin

Most of these candidates went on to gain all three marks, though some never got past the stage of relating 180 g of aspirin to 40 g of sodium hydroxide and a few were out by a factor of 10. Some candidates used an alternative approach to obtain the correct answer and were given full credit. A very wide variety of incorrect calculations were seen, most with no relevance to the question. Many candidates worked out the mass of sodium hydroxide in 27.4 cm^3 of solution but did not know what to do with the answer. In (iii) more able candidates realised that it was important to look at the range but only a few of these could explain how to use the range to assess uncertainty. Many weaker candidates suggested repeating the titration more carefully.

Q5 This question again showed the weakness of most candidates when attempting calculations.

(a) Most candidates correctly read 34°C from the graph. Common incorrect responses were 32 and 52.

(b) Only the more able could put the correct formulae into this equation.
$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$
Most of these managed to balance the equation correctly.

Moderation Report on GCSE Chemistry A

GCSE Science A, Additional Science A, Biology A, Chemistry A and Physics A

General Comments

This is the last year of operation of this specification and it has clearly been a most rewarding experience for the teachers and students involved. It has also been a pleasure for the moderating team to see the imaginative ideas that teachers have developed to engage their students and inspire them to show the best of their skills in the assessment. **For next summer, tasks will be set by OCR under the new Controlled Assessment procedures and Centres must check the new unit entry codes and other requirements.**

There has been a continued improvement in a number of areas in the interpretation and application of the assessment criteria. However, certain aspects have continued to be demanding and challenging for candidates and the spread of marks over the cohort is sufficient to allow secure differentiation between grades.

Section 1: Administrative issues

Whilst the majority of Centres have excellent administrative procedures in place there were still a significant number who caused the moderating team a considerable amount of extra work to ensure that candidates were credited with the correct marks. Few Centres included details of how each of the tasks used for assessment had been introduced and presented to candidates and this meant that on occasions moderators could not easily find the evidence to support the marks that were awarded by the Centre.

Most candidates' work was annotated with the use of the assessment criteria codes, however, in a number of cases the annotation was a very generous interpretation of the criteria and sometimes completely incorrect.

There was evidence that some coursework from a small minority of Centres had been reviewed and annotated by teachers giving candidates specific guidance about how to improve their marks. Another example of unacceptable assistance included the use of helpsheets giving detailed task specific points and leading questions involving particular words or phrases in the mark descriptions.

There was evidence that in some cases, particularly in the Case Study, candidates were copying and pasting information from websites without acknowledgement and referencing of the source. This action constitutes malpractice, for which a penalty may be applied.

Section 2: Assessment and marking framework

A significant number of Centres were still not following the correct procedure for calculating the Strand mark from the appropriate aspect of performance marks and were required to re-calculate or re-mark their candidates' work. Each aspect of performance should be considered in turn, comparing the piece of work first against the lowest performance description, then each subsequent higher one in a hierarchical manner until the work no longer matches the performance description. There was a tendency for some Centres to award marks on the basis of candidates matching one high level aspect of performance description within each Strand without ensuring that the underpinning descriptions had been matched.

Section 3: Data Analysis

General comments

Those candidates who understood and used the terminology and concepts related to Ideas about Science, such as 'correlation and cause', 'outliers', 'reliability', 'accuracy', 'best estimate' and 'real difference' found it easier to match the performance descriptions of the criteria and gain higher marks.

The majority of candidates at nearly all levels repeated their measurements when performing practical tasks. However, they did not necessarily appreciate the reasoning behind such practice and often those results which were clearly outliers were included in calculating averages and incorporated into conclusions. It was very rare to see that a candidate had performed further repeats to replace the outlier to ensure that the data is reliable and of the best quality. Plotting rough graphs as the data is collected may help candidates to identify outliers as they are collected.

Strand I: Interpreting data

Whilst many candidates now plot all their data and often include range bars, the quality of graph drawing often shows lack of care in plotting the points accurately or using suitable scales and labelling axes correctly or drawing a line of best fit accurately and carefully. Many graphs were given high marks when one or more of these aspects were not of the accepted quality.

The match to I(b)4, 'identifying trends or general correlations in the data', was well appreciated. However, many candidates referred to 'positive correlation' which only merits 4 marks rather than the 6 marks which was often awarded. For 6 marks candidates should derive a more quantitative statement using their data to show what happens when, for example, concentration or lengths are doubled and noting the direct proportionality between variables.

Most candidates could secure a match to I(c)4 by explaining their conclusion using scientific ideas. However, there was still some very generous marking when matching to I(c)6 and I(c)8 in terms of the detail and quality of the scientific knowledge and understanding shown.

Strand E: Evaluation

Those candidates who used sub-headings such as 'Evaluation of procedures', 'Evaluation of data', 'Confidence level of conclusion' were more likely to focus on each area in turn and be more successful in their overall evaluation.

Most candidates could identify limitations or problems in their procedures to match E(a)4 although in many cases comments were limited to human error rather than systemic experimental ones. A number of the suggestions for improvements were not of sufficient quality to securely match E(a)6.

The majority of candidates generally identified a data point as an outlier either in the table of results or on a graph with range bars to match E(b)4, but only the better candidates provided an explanation of why a particular result had been chosen. The majority of candidates now regularly draw lines of best fit and range bars on their graphs but many of them do not make the connection to reliability and accuracy when discussing their data.

Marks for E(c) were often very generously awarded and this aspect still continues to be poorly addressed. Better candidates referred back to their conclusion in I(b) expressed in either qualitative or quantitative terms and used their discussion in E(a) and E(b) to link them all together in establishing the appropriate level of confidence.

Section 4: Case Studies

General comments

The Case Study is a critical analysis of a controversial scientific issue in which candidates use their knowledge and understanding of Ideas about Science. Those candidates who were able to use the language and concepts related to IaS, found it much easier to match the performance descriptions of the criteria and gain higher marks.

In general, candidates continued to perform better in Strands A and D compared to B and C. Higher achieving candidates described the relevant science needed to understand their chosen topics and produced high quality, clearly structured, well resourced and illustrated reports involving critical analysis and individual thought with considerable personal input. It was this latter aspect of personal analysis and evaluation which often differentiated candidates in terms of level of performance. Lower achieving candidates relied too heavily on copying and pasting information from sources without the appropriate level of individual analysis and evaluation.

Strand A: Quality of selection and use of information

The majority of candidates included a bibliography of sources with the majority from the internet at the end of their reports with complete references to the exact URL address of the webpage. Only the better candidates provided some information about the nature, purpose or sponsorship of the site. Candidates were still not very good at clearly showing where sections of text were directly quoted. Better candidates also included references within the text to show the source of particular information quoting the specific author and then explaining why it was chosen and how it contributed to the arguments being compared.

Strand B: Quality of understanding of the Case

Only the most able candidates could integrate their scientific knowledge and understanding with the claims and opinions reported in their studies or extend the scientific knowledge base to more advanced concepts. Reporting was too often still at the ‘headline level’, simply repeating claims without looking behind the headline for the underlying science and/or evidence. Candidates who were awarded 6 marks referred to the evidence base of the various claims and opinions providing generally quantitative information from research studies. Candidates obtaining 7 or 8 marks looked more critically at the quality of the evidence. They used terms like ‘reliability’ and ‘accuracy’ when considering data, they looked at the strategies involved in collecting the data and they also compared the reliability of data between sources.

Strand C: Quality of conclusions

Most candidates could sort the information that they had gathered into views ‘for and against’ and were awarded 4 marks in C(a). Better candidates started to compare similar aspects in both their ‘for and against’ list and were awarded 6 marks. The best candidates built on this foundation and provided detailed comparisons and evaluation demonstrating considerable analytical and evaluative skills. When making their conclusions, the best candidates described their own viewpoint or position in relation to the original question justifying this by reference to the sources and to the evidence that the claims were based on. Many candidates simply chose to report information about their topic, without any real analysis of the scientific evidence and incorporation of personal decision making.

Strand D: Quality of presentation

The majority of reports included headings and/or sub-headings (2 marks), a table of contents and numbered pages (3 marks) to help guide readers quickly to particular sections. Those candidates who in addition presented a report which had a coherent, logical and consistent style were awarded 4 marks. More candidates now include informative images but only the best candidates refer to and use the information to clarify difficult scientific ideas and improve effective communication.

Section 5: Investigations

Rates of reaction, resistance of a wire and osmosis were still the most common investigations seen from Centres.

Strand S: Strategy

Although there was evidence of candidates doing preliminary work, it was often the case that candidates from the same Centre used the same quantities of materials, the same apparatus and technique and identical ranges and values of the same variables. This clearly indicated that limited individual decision making had occurred. The best candidates performed preliminary work and used the data collected to inform and develop the main experiment. These candidates considered what factors or conditions might affect their results which usually involved a brief review of the relevant scientific theory supported by one or two simple practical experiments to compare the magnitude of the different effects and ease of experimentation. This allowed candidates to decide which factor it would be best to study and also provide evidence which could contribute towards credit for C(a) and C(c).

Many candidates provided a list of appropriate apparatus for their investigations but had not linked it to their preliminary work and not indicated why the apparatus had been selected in preference to alternative equipment.

The complexity of a task, S(a) depends on the demand and challenge involved in the approach adopted by the candidate and too often 7 or 8 marks were awarded for straightforward approaches to the task. ‘Resistance of a wire’ investigations were frequently over marked in this aspect.

Strand C: Collecting data

It was pleasing to see that the majority of candidates used suitable ranges of the appropriate variable to study and appreciated the need to repeat their measurements to obtain a wide range of data. However, a discussion of the factors to control was often rather limited for C(a) and only the better candidates described in detail how the factors had been controlled and monitored during the experiment.

There was continuing evidence this year that candidates were doing preliminary work to establish the range of values of the appropriate variable to be used C(b). However, although some candidates presented their results in a table they did not use the results to explain how it informed their main method. Too often, candidates did not consider their results as they were being collected so that obvious outliers were either ignored, or included without comment when calculating average values. It was very rare to see that a candidate had performed further repeats to replace the outlier to ensure that the data was reliable and of the best quality.

From inspection of results tables it was pleasing to see that candidates were taking more care and data was generally of good quality. However, there was little evidence of candidates performing preliminary work which involved making decisions about adapting the type of apparatus or method to ensure the collection of the most accurate and reliable data (C(c)).

Strands I and E

In general candidates achieved their poorest marks in these two Strands. For more details see the comments in the Data Analysis section.

The Twenty First Century Science model for Investigations aims to give credit for candidates who process their results, look for patterns and then suggest explanations using their scientific knowledge and understanding. Very often candidates did not link their conclusions with their scientific explanations I(c).

Strand P: Presentation

This Strand was generally fairly and accurately marked by Centres. Spelling, punctuation and grammar were sound and the majority of candidates' reports were well structured and organised. However, experimental methods were rather briefly described and lacked sufficient detail. Diagrams of apparatus were not always included and although data was generally accurately recorded and presented in appropriate tabular form, units were occasionally incorrect or missing.

Section 6: Final comment

All members of the moderating team recognise the considerable effort needed by Centres in assessing and presenting candidates' work for moderation. We would like to record our thanks and appreciation for a thorough and professional job carried out by the majority of Centres.

The structure of Case Studies, Data Tasks and Investigations has been modified in the new specifications in the light of the new regulations for Controlled Assessment. Training for the new model is on-going and details are available in the OCR Training Handbook. There is further guidance about the interpretation and application of the new assessment criteria on the website www.ocr.org.uk.

This seems an appropriate opportunity to thank Centres for the care taken each year in presenting work in such a well organised manner, and to wish you continued success with the new Controlled Assessment.

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