OCR
RECOGNISING ACHIEVEMENT

GCSE

Chemistry A
Twenty First Century Science

General Certificate of Secondary Education **J634**

Report on the Units

January 2009

J634/MS/R/09J

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, GCSEs, OCR Nationals, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new syllabuses to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

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 syllabus 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.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

CONTENTS

GCSE Twenty First Century Science - Chemistry A (J634)

REPORTS ON THE UNITS

Chief Examiner's Summary

Many candidates were well prepared for the examination papers and showed a good grasp of the chemistry modules. Weaker candidates performed less well, but most made a good attempt at all of the questions. Relatively few 'no response' answers were seen. All papers gave good discrimination, giving more able candidates the opportunity to score highly whilst allowing weaker candidates to score a reasonable number of marks. Few candidates had been entered for an inappropriate tier.

A problem that was apparent across all of the papers arose from the tendency by many candidates to change their answers. Whilst some crossed out their previous answer and made the new one clear, writing it to the side if necessary, others left considerable doubt as to which answer should be marked. Where lines had to be drawn between boxes, some candidates left a confusion of crossed out lines that made marking difficult. Where the answer is unclear no mark can be given, and this cost marks for a number of candidates.

Where candidates are asked to tick the box next to each correct or best answer, in most questions they are clearly told how many boxes must be ticked. Despite this some candidates ticked fewer or greater than the required number. Though this applied to a minority of candidates, again it resulted in a loss of marks.

The Principal Examiners' reports which follow indicate

- gaps in factual knowledge,
- common errors which reveal misconceptions, both in *Ideas about Science* and in *Science Explanations*, and
- places where the candidates did not follow the instructions in the questions.

Important changes to papers A321 and A322 from January 2010

Up to, and including, June 2009, the current model for the objective style question papers will continue to be used. In these papers, all questions currently require objective responses: candidates select from a defined set of alternative responses or provide a short answer which is expected to be clear and unambiguous.

From, and including, January 2010 a new style of question will be introduced to these papers. While the majority of questions will continue to be objective, following the current format, a number of questions on both Foundation and Higher tiers will be open-ended, requiring candidates to provide longer written answers without selecting from a set of alternatives. Each of these responses will be worth from 1 to 4 marks, providing candidates with opportunities to organise information, develop arguments, analyse and evaluate.

The papers affected all carry 42 marks. These open-ended questions will in total carry 12-14 marks of those available, with the remaining 28-30 marks continuing to be assessed with objective style questions.

New specimen assessment materials for these papers have been developed and are awaiting approval by QCA. As soon as they have been approved, centres will be informed with a further 'Notice to Centres' and the papers will be made available on the OCR website (www.ocr.org.uk). At the same time, revised specifications will be published to reflect these changes. No other significant changes have been made to the specifications, but a small number of minor corrections and clarifications will be included and highlighted at the time of publication.

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

General Comments

The paper was generally well attempted. All candidates appeared to have time to complete the paper, and very few candidates were entered inappropriately for this tier.

There were several examples of candidates crossing out their original answer and replacing it. This does show that candidates were thinking very carefully about the questions. However, it is important to make the final version clear. It is always safer to write the new answer alongside the old one, NOT on top of it. Examiners were concerned that some candidates may have lost marks because their intentions were not clear enough to safely give credit.

Comments on individual questions

1a This question was well answered with most candidates scoring two out of the three marks. Many scored all three. The most common mistakes occurred with argon. Some candidates lost marks by putting the same gas in both columns.

1b This question discriminated well, able candidates were able to state which atoms came from the petrol, which from the air. It is always difficult to determine the underlying misunderstandings of the weaker candidates, but it is possible that here they did not recognise the term ‘product’ and so were not certain what the question was asking for.

1c Most candidates knew that carbon dioxide is removed from the air by photosynthesis. Stronger candidates also knew that it dissolves in seawater. Weaker candidates often chose “it is deposited on surfaces, making them dirty” as their second response. Some of the weakest candidates assumed that it is lost into outer space.

2ai Able candidates linked the statements about sulfur dioxide and coal burning power stations correctly. Weaker candidates were usually able to score one of the marks. However, they appeared not to use the graph, and so were more likely to suggest that there was an increase in the number of coal burning power stations rather than a decrease. It must be stressed that candidates should use the information given to them in the question.

2aii This question was well attempted.

2aiii While most candidates identified flue gas removal as a cause of lowered sulfur dioxide levels, they had much more difficulty in recognising that the introduction of low-sulfur fuels the other factor.

2b Many candidates found it difficult to use the shaded circles to show a formula of carbon dioxide, though the more able still performed a lot better than weaker candidates.

3a Cotton and wool were widely recognised as coming from living things. Able candidates also identified silk, whereas others often chose nylon.

3b Advantages and disadvantages of poly(ethene) were well understood, the most common mistake was to think that it was an advantage that it does not rot when thrown away.

3c This question caused considerable problems for candidates. Most realised that "pure water" is a single chemical. More able candidates often realised that milk is a mixture but could not decide on wood, whereas weaker candidate often realised that wood is a mixture but could not decide on milk. Most candidates viewed iron as a mixture.

4ai While many candidates assumed that technician A had produced results which contained an outlier, the most able correctly realised that the problem was more that there was too large a range.

4aii The outlier in technician C's results was correctly identified by almost all candidates.

4aiii Candidates were expected to take the mean of technician B's results, and the distribution was made symmetrical to aid the calculation. This was a difficult task, and answers '11', '13', or '11 to 13' were common.

4aiv Many candidates scored the first mark by realising that there would be small variations between different sample of the rubber. They often paired that with the general statement about a fair test. Candidates who put the 'reduction in random errors' statement as their second choice showed an understanding that it is these two factors which actually made the experiment a fair test, and so scored both the marks.

4b Many candidates had an understanding of what it means for a resource to be sustainable, but found it much harder to chose two statements which showed that natural rubber production is more sustainable than that of synthetic rubber.
Consequently, most chose the statement that we can take liquid sap from the same tree every year, but only a few chose as their second statement that crude oil is a finite resource. Instead, they often chose the third response "It is easier to make rubber from sap than from crude oil."

5a Many candidates experienced difficulty interpreting the nitrogen cycle.

5ai Able candidates correctly located the process which involved decay.

5aii Very few candidates could see which change must involve bacteria in plant roots. C and E were the most common responses.

5aiii Some candidates realised that it was process A which must involve lightning. Many suggested process B.

5b Able candidates knew that proteins contain hydrogen and oxygen. Weaker candidates often went for calcium, and also for iron and sodium. Almost all candidates realised that argon is not present in protein.

5c Able candidates realised that fertiliser is used to prevent the land becoming less fertile, but often linked that to the evaporation of liquid nitrogen. Conversely, weaker candidates correctly stated that crops remove nitrogen from the field, but went on to link that to weed growth.

6 Candidates showed some difficulties in interpreting food labels for part 6a, but went on to answer the rest of this question very well.

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

General Comments:

Almost all candidates made a good attempt at this paper, with very few questions left blank. More able candidates showed good knowledge and understanding of modules C1, C2 and C3. Most of these were able to apply this knowledge and understanding successfully to the majority of questions on the paper. Many weaker candidates, however, showed sound ability in some areas but weakness in others. Only a small minority showed a general weakness across all three modules.

The majority of candidates followed the rubric to answer the questions, for example ticking the number of boxes stated. It was noticeable, however, that a number of weaker candidates ticked two boxes for answers that only asked for one. Many candidates struggled in questions where two statements had to be chosen to illustrate one concept.

Most candidates could interpret data well, though a number did not exclude an outlier when calculating a mean. Other areas with noticeable weakness shown by a significant number of candidates were some aspects of the nitrogen cycle and conservation of atoms in a reaction.

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

Q1 Most candidates were able to interpret the data in this question to gain some marks, but only the more able could do this consistently through the question.

(a) In (i) a majority of candidates realised that the results from technician A had a wide range and gained the mark. Many weaker candidates incorrectly thought that the results contained an outlier. In (ii) most candidates gained at least one mark. Weaker candidates used all of the results to work out a mean of 11 for one mark, but more able candidates recognised and excluded the outlier to work out a mean of 12 for two marks. Most candidates gained one of the two marks in (iii), but only the more able gained both. Many candidates incorrectly thought a number of measurements are needed to give fair testing.

(b) This question was answered better than similar ones in previous sessions. Many candidates gained one mark and most of the more able gained both. Incorrect answers were randomly spread across the incorrect responses.

(c) This question discriminated well. The majority of candidates gained one mark, most commonly realising that crude oil is finite, but only the more able gained the second mark.

Q2 Most candidates showed that they had some knowledge of the nitrogen cycle and could interpret the diagram. Knowledge of NPK elements was largely confined to the more able.

(a) The majority of candidates gained the mark in parts (i) and (iii), but very few gave the correct answer in (ii). Here the majority incorrectly thought that bacteria in the roots of plants are involved in making protein in plants rather than producing nitrogen compounds that may then enter the soil.

(b) Most candidates gained one of the two marks, for either hydrogen or oxygen, but only the more able gained both. A wide variety of incorrect elements were suggested.

(c) Only the more able candidate gained any marks here, with the most able gaining both. Many candidates suggested oxygen or hydrogen, though a wide variety of other elements were suggested. Many candidates who correctly suggested potassium or phosphorus could not spell these names correctly.

Q3 Most candidates could interpret the information about toxic chemicals in food quite well. More able candidates showed a good appreciation of the ideas of risk and the precautionary principle.

(a) The majority of candidates gained two marks, with most reversing the correct sequence for the last two boxes in the 'contamination' column. Many of the more able candidates gained all three marks.

(b) In (i) most candidates scored at least one mark, with the more able scoring both. Performance in (ii) followed a similar pattern, but with a little less success. Incorrect answers in both parts showed no definite pattern.

Q4 Most candidates showed some knowledge of how pollutants were formed, but only the most able could correctly answer the second part.

(a) Many candidates gained two marks, usually for the first and fourth boxes, but fewer could correctly identify the third correct statement.

(b) Only the more able candidates understood what was required in this question. Most of these gained both marks. Weaker candidates generally gave the number of atoms in one molecule of carbon dioxide or water rather than the total in all of the molecules produced from the combustion of one molecule of propane. Many of the weaker candidates wrote answers in the shaded boxes as well as the answer boxes.

Q5 Weaker candidates struggled with the concepts upon which these questions were based. More able candidates performed well.

(a) The majority of candidates gained the mark in (i) but only the more able could identify both of the correct statements to gain the mark in (ii). Candidates found (iii) very difficult, with only a few of the most able realising that the correct statements were B and D. Many chose one correct statement but combined it with an incorrect one. In (iv) most candidates gained at least one mark, with the more able scoring both.

(b) Most of the weaker candidates incorrectly included the letter E in their answer, so losing both marks. More able candidates realised that E should not be included and most of these gave the correct sequence to gain both marks.

(c) There was a noticeable improvement over the performance of candidates in similar questions in previous sessions. Only the weakest candidates could not combine one black circle with two white circles to gain one mark. Most of the more able candidates included a second correct diagram to gain both marks.

Q6 Weaker candidates were able to gain some marks, but only the more able showed a good knowledge and understanding of the concepts involved in these aspects of polymer chemistry.

(a) Many candidates gained one mark but only the more able gained both. Statements involving sustainability and pollution were common incorrect answers. A significant number of weaker candidates gained no marks.

(b) Most candidates chose two or three correct words to gain one mark. Only the more able chose all four words correctly to gain both marks. Common errors were monomer instead of plasticizer, atoms instead of chains and burns instead of melts.

(c) Most of the more able candidates gained this mark. The full range of incorrect answers was seen from weaker candidates.

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

General Comments:

Whilst the more able candidates showed a sound knowledge and understanding at this level across modules C4, C5 and C6, others evidenced severe weakness in many areas. The most common questions found difficult by the majority of candidates were those involving formulae and calculations. Many of the answers given by weaker candidate showed a good appreciation of simple concepts but others showed a lack of even the most basic understanding.

When presented with a number of statements with tick boxes, only a small number of the weaker candidates frequently ticked fewer or greater than the number of boxes required. Similarly, only a few of the least able candidates left a significant number of questions unanswered.

The overall spread of questions gave all candidates of appropriate ability for this paper 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.

Q1 This question allowed most candidates, even the weaker ones, to gain some marks.

(a) The majority of candidates gained both of these marks, with only the weakest making errors.

(b) Most candidates knew that these chemicals are hazardous and so gained this mark. All of the incorrect responses were seen from very weak candidates.

(c) All but the weakest candidate knew the symbol for sodium. The most common incorrect response was So.

(d) Most candidates recognised the appearance of sodium to gain both marks from this question. The majority of weaker candidates gained one mark, with very few failing to score.

(e) More able candidates scored at least one mark, and many both marks, for this question. Common errors for weaker candidate were thinking that calcium reacts with sodium to make salt and is in the same group as sodium.

Q2 More able candidates performed well in this question, but weaker candidates struggled.

(a) All but the best candidates found this question difficult. Many picked the correct words but put them in the wrong places.

(b) Only the most able candidates performed well in this question, but many weaker candidates gained one mark, usually for nine protons.

Q3 Only the more able candidates could recognise the molecules diagrams well.

(a) More able candidates made a good effort, with most gaining two of the three marks. Many of the less able candidates did not score. A very common error was to join O_2 to the diagram showing a hydrogen molecule.

(b) Most candidates gained one mark and most of the more able gained both. The most common error was to think it false that there are weak forces of attraction between gas molecules.

Q4 Parts of this question tested the abilities of candidates, with only the more able scoring well.

(a) Only the most able could successfully calculate the percentage of other elements. A very wide variety of incorrect values were seen, the most common being 0.5.

(b) All but the weaker candidates ticked the two correct boxes to gain the mark in (i). A few candidates ticked only one box. In (ii) most candidates gained at least one mark, with many of the more able gaining both.

(c) Only the most able realised that the waste rock left over would harm the environment to gain this mark. All of the incorrect responses were seen from weaker candidates.

(d) Very few candidates gained this mark, with little difference in performance between weaker and more able.

Q5 More able candidates gave at least two correct words to gain one mark, and some gave all three to gain both marks. Common errors were positive instead of negative and hydrogen instead of oxygen.

Q6 Formulae and calculations, though simple, proved to be too much for most candidates.

(a) Very few candidates could name sulfuric acid, and even fewer could give its formula. Only a very small number of candidates gained even one mark. The most common incorrect response was sulfur and S, though a wide variety of names and formulae were seen.

(b) Only the more able realised that litmus paper would not show the pH of the acid. All of the incorrect answers were often seen.

(c) Most candidates gave two or three correct words to gain one mark. Only the most able gave all four correct words to gain both marks. The first choice of words, between smaller and larger, and the last choice, between more and less, were the most common to be chosen incorrectly.

(d) Only the more able candidates could correctly work out the relative formula mass in (i) and choose the correct percentage yield in (ii). A wide variety of values were seen for the former, and each of the incorrect choices many times for the latter.

(e) Many candidates gained one mark, usually for the ideas of Liz spilling some of her product, but only the more able gained both.

(f) Few of the weaker candidates realised that purity of the product is essential for eye drops, though a greater proportion of the more able candidate did.

Q7 This question proved to be an accessible one for almost all candidates.

(a) Almost all candidates gained all three marks for this question.

(b) All but the weakest candidates gained both marks for this question.

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

General Comments:

Candidates made very good use of their time, with very few 'no responses' seen.

In part questions where candidates were asked to write answers e.g. equations, candidates often changed their minds and wrote over earlier answers. Sometimes this made it very difficult to read the candidate's response. Candidates should be told that if they want to amend their answers, they should cross out their answer and re-write their new one clearly below, above, or to the side of the answer space.

Q1

a) Only the most able candidates scored three marks for this equation. Most knew the name and formula for hydrogen, but many thought 'water' or 'oxygen' was a product of the reaction. Incorrect formulae for sodium hydroxide were often seen, and many tried to balance the equation by changing the formulae. Answers such as 'Na_2' were very common.

b) Most knew that sodium is shiny when cut, fewer knew that it dulls quickly in air.

c) A single mark was awarded for two correct boxes, so that most candidates gained one mark. However, few interpreted the symbol of sodium well enough to classify more than two or three responses correctly as true or false.

d) Almost all candidates correctly linked the elements to their descriptions.

Q2

a) Almost all knew that a flame test gives a characteristic flame colour.

b) The symbol for a calcium ion was not well known. Most gave the correct element symbol, Ca, but few gave the correct 2+ charge. Some candidates confused sub- and super-scripts, giving answers such as Ca_2^+

c) Candidates found this the most difficult part question from question 2, but many did know that the chloride ion has 8 electrons in its outer shell.

d) Some candidates only ticked one box here, despite the question clearly asking for two ticks. Most gave at least one correct choice, but calcium being a metal and the solution containing water molecules were frequent incorrect choices.

Q3

a) The most difficult molecule to identify here was oxygen, because two of the choices were diatomic elements. Most candidates scored (2) of the three available marks. It was relatively common for candidates to draw lots of lines, crossed out and written over so that it was difficult for examiners to see clearly what the candidate's final choice was supposed to be. Candidates should be advised to consider carefully before committing to drawing their line in for this type of question.

bi) Very few knew that oxygen was one of the most abundant elements in the Earth's crust.

bii) Almost all candidates knew that iron is not found in the atmosphere.

Q4

a) The candidates found it very straightforward to handle the data in the table, despite the use of many negative numbers.

b) Again, this question had a very high facility.

c) Candidates had no problem identifying the ionically bonded compound.

Q5

a) Candidates were equally well hung here between the choice of 'reduction' (correct) and 'oxidation' (incorrect). Very few went for the other distracters.

b) Many knew that aluminium is more difficult to extract due to its reactivity, but many chose other incorrect answers, typically that aluminium does not react with oxygen or has a high melting point.

c) The electronic equation was very challenging. Very few gave both the correct symbol for aluminium and the correct number of electrons. Many candidates tried to write equations involving oxygen or oxides.

d) Most were able to link at least one of the statements to the harm to the environment that extraction causes. Again, some candidates only chose a single statement rather than the two that the question demanded.

Q6

a) Most worked out a formula for sulfuric acid by counting up the atoms in the equation, which was ingenious enough to gain a mark. Hence answers such as 'SH_2O_4' were often seen. Fewer could name the acid, and answers such as 'hydrochloric' were surprisingly common. Again here, some candidates changed their minds so many times that it was difficult to read their answers.

bi) Not all chose litmus as the correct answer. Strangely, 'pH probe' was a common choice of apparatus that could not be used to measure pH.

bii) Many candidates think that the pH falls as the acid is neutralised.

c) These two calculations were very well done. A majority of candidates correctly gave '8.05g', although '8.2g' was a popular incorrect choice. In (ii), again, the correct answer 243 g was given by most candidates.

d) This question is a different type of question to those usually asked about yield. In this case the yield was unexpectedly high. Most candidates were able to identify at least one reason for this. Again, some only chose one, rather than 2 boxes.

e Most chose the correct answer, but all three distracters were regularly seen.

Q7

ai) The interpretation of the graph proved straightforward for most candidates. Most chose the correct answer that the area 'A' on the graph showed the fasted reaction.

aii) Again, most knew that the acid would be at its least concentrated when the reaction stopped (area D).

b) The interpretation of the changing conditions was the most difficult part of this question, but over half the candidates chose the correct answer.

d) Most gained at least one for choosing the correct outcomes of a rise in temperature.

Grade Thresholds

General Certificate of Secondary Education
Chemistry A (Specification Code J634)
January 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A*	A	B	C	D	E	F	G	U
A321/01	Raw	42	N/A	N/A	N/A	27	22	18	14	10	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A321/02	Raw	42	34	29	23	18	12	9	N/A	N/A	0
	UMS	50	45	40	35	30	25	20	N/A	N/A	0
A322/01	Raw	42	N/A	N/A	N/A	28	25	22	19	16	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A322/02	Raw	42	38	32	25	19	14	11	N/A	N/A	0
	UMS	50	45	40	35	30	25	20	N/A	N/A	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A*	A	B	C	D	E	F	G	U
J634	300	270	240	210	180	150	120	90	60	0

The cumulative percentage of candidates awarded each grade was as follows:

	A*	A	B	C	D	E	F	G	U	Total No. of Cands
J634	20.0	40.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	5

128 candidates were entered for aggregation this series.

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553