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GCSE

Chemistry A

Twenty First Century Science Suite

General Certificate of Secondary Education **J634**

Examiners' Reports

June 2011

J634/R/11

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Chief Examiner's Report

Candidates who had good knowledge and understanding across the modules and a good grasp of the concepts involved performed well. Some very good answers were seen.

There were encouraging signs of improvement in performance on free response questions. Fewer candidates left these questions unanswered and most attempted to address what was being asked, though long and vague answers were common. Where two or three marks were available it was common for candidates to express only one idea, hence scoring only one mark. Many candidates repeated part of the question at the beginning of their answers. Others expressed the same idea two or more times in the same answer. It was not unusual to see answers that continued beyond the lines allocated, often continuing into the next question or running down the left or right of the page.

Performance in the objective questions was similar to previous sessions. Few candidates left these questions unanswered though some failed to follow the rubric, particularly that relating 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.

In the A323 papers (Ideas in Context plus module C7), most candidates performed well on questions set from the pre-release material. However, knowledge and understanding of module C7 shown by many candidates was again far from satisfactory. A large number struggled to answer questions set on this part of the specification, with many showing very little familiarity with the concepts involved. There was, however, some improvement in the performance of more able candidates when compared with previous sessions.

All papers discriminated 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 engaged with the majority of the paper. Exceptions were Q.3 (c) and Q.5 (c) (see below). The time allocation was suitable and very few responses were noted where candidates had not attempted the question.

Some candidates still entered an incorrect number of ticks despite the questions referring to the number of ticks required. For example, when instructed to 'put a tick next to the two best answers', some candidates offered three responses.

Candidates seemed better prepared to retrieve information from the tables of data and they could identify reasons to increase the amount of data collected. They also seemed more aware of the ideas of range, best estimate and outliers, although some misconceptions still exist about 'fair testing' and 'reliability'.

Identifying properties seemed to be a challenge for many candidates, particularly when relating those properties to polymers.

Advantages and disadvantages of organic farming proved to be areas of uncertainty for most candidates.

The free response questions proved difficult for the foundation tier candidates. The answers were often jumbled and some candidates simply repeated information from the stem of the question rather than offering new information.

Comments on Individual Questions

1 (a) (i) Candidates often scored no marks due to incorrect rounding of the correct calculation. In the absence of any working, no credit could be awarded for such responses. The most common wrong answers were 110 or 112. Some candidates who gave incorrect answers but had followed instructions to show their working gained 1 mark.

1 (a) (ii) Candidates on the whole demonstrated a good understanding of the term 'range'.

1 (a) (iii) Candidates struggled to make the link between the reliability of the results being demonstrated in a limited or smaller range.

1 (a) (iv) Candidates appeared to be more aware of the ideas of outliers, calculating an average or mean and the inaccuracy of measurements being linked to reliability. Very few candidates could put their ideas together to score both marks.

1 (b) This was well answered. Candidates could differentiate between data and opinion, although 'Andrew' caused the most errors, resulting in some candidates scoring 2 rather than all 3 marks.

2 (a) Candidates' responses were often unstructured and difficult to unravel. They tended to reword the stem of the question rather than offer new information.

Where candidates did offer correct responses, 'sharing cars' and 'less cars' were the most common correct ideas. References to nitrogen dioxide were seen. This occurred more frequently than the idea of 'using public transport' and 'burning less fuel'.

2 (b) Few candidates gained both marks here by linking the two statements together. Most candidates could however identify at least one of the two statements that gave the best response.

3 (a) This was quite low scoring for a lower demand question. Candidates did not engage in the question. The candidates who scored marks here tended to score for the idea of 'using the product' in some way. The common misconception comes from the stage between collecting the natural resources and manufacturing the product from those resources. This was demonstrated by the candidates who put 'used' in the first space. Lots of ideas about buying and selling were offered. These elements of the process have no impact on the Life Cycle Assessment of the product.

3 (b) Generally well answered with many candidates scoring both marks.

3 (c) Candidates could not engage with this question. A very limited number of candidates scored marks here. Candidates tended to write everything they knew about polymers and cross-linking. Unfortunately most of this had been given in the stem of the question. There was lots of confusion between polymers, molecules, chains and fibres.

4 (a) Very well answered as candidates could read information from the table.

4 (b) Most candidates struggled to pick out one of the correct statements. Very few candidates could identify both correct statements.

4 (c) Most candidates could identify at least 2 properties from the information in the table and give comparative statements. Few candidates failed to score here.

4 (d) (i) Only a limited number of candidates could identify the link between the flexibility of a polymer and the addition of a plasticizer.

4 (d) (ii) Generally well answered as most candidates could identify the outlier.

5 (a) Most candidates could identify at least one activity that would change if the type of farming changed from intensive to organic.

5 (b) (i) Candidates struggled to identify the advantage of organic farming from the list given here.

5 (b) (ii) Candidates again struggled with this question. The disadvantages were as difficult to identify as the advantages. The most common misconception was that 'the fertility of the soil on Joe's farm will decrease'.

5 (c) Despite the ability of candidates to identify ideas about sustainability in earlier multiple choice style questions, in this question they struggled to formulate a written response with any clarity or scientific content. Many misconceptions were demonstrated here. These included Joe being able to charge more for his crops because organic food is healthier and organic farming being better for the environment. Very few candidates identified the importance of crude oil as a finite resource or its relevance for producing fertilisers etc.

6 (a) Candidates could identify the elements present in a hydrocarbon but there were very few candidates who could identify the elements present in either a sugar or a protein.

6 (b) Most candidates could identify at least one correct statement describing what happens to sugar when it is taken into the body.

6 (c) Most candidates could identify at least one purpose of a preservative.

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

General Comments

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

The majority of candidates followed instructions carefully. However, a number of weaker candidates ticked an incorrect number of boxes to that stated in the rubric, sometimes ticking more and at other times less than the required number. This was particularly noted when, for example, a question requiring two boxes to be ticked was followed by a question requiring just one box to be ticked or vice versa.

Most candidates could interpret data well, but a surprising number did not identify and discard an outlier when calculating an average. Concepts, such as the sustainability of products made from different materials and the cross-linking of polymers, were poorly understood by the majority. Other areas of the specification which many candidates found particularly challenging included the nitrogen cycle, correlation and cause, sulfur dioxide pollution and the metabolism of food molecules.

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

Comments on Individual Questions

1 More able candidates scored well in this question, but others struggled with some of the concepts and particularly with the longer answer in (c).

(a) The majority of candidates removed the outlier to calculate correctly the mean as a best estimate in (i).

451+447+453+449)/4 = 450

Many weaker candidates included the outlier, restricting their score to one mark. Only the weakest scored no marks.

In (ii) more able candidates knew that a real difference was shown by the mean sulfur dioxide concentration for B not being within the range for A. A common incorrect answer was the mean at A being larger than that at B, though all distracters were seen often.

The majority of candidates knew that a smaller range indicates more reliable measurements and so gained the mark in (iii). There was no pattern in the incorrect responses.

(b) Most candidates realised that Amy is describing a correlation to gain the mark in (i). Only the weakest candidates chose incorrectly.

Almost all candidates knew that Andrew is suggesting replication by other scientists to gain the mark in (ii).

Only the most able realised that Clarissa is explaining a causal link to gain the mark in (iii). All four incorrect answers were seen often.

(c) Only the more able scored marks in this question, usually for suggestions involving the burning of low sulfur fuels or the fitting of a device to remove sulfur dioxide from flue gases. Very few gained both marks. Many weaker candidates suggested that the power station should reduce output, use a renewable energy source or even be moved elsewhere, none of which gained credit.

2 This question gave plenty of opportunity for most candidates to gain marks.

(a) The majority of candidates scored three or four marks, with only the weakest not scoring at all. The idea that car sharing reduced the number of cars going into the town was given by many, and some of the more able candidates continued that this reduced fuel consumption and therefore nitrogen dioxide emissions.

(b) Most candidates completed one of the sentences correctly, but far fewer managed both. Common errors were thinking that nitrogen and oxygen come from the fuel and writing nitrogen oxide instead of nitrogen monoxide.

3 The concepts involved in cross linking of polymers proved to be beyond the understanding of most candidates.

(a) A large majority gained both marks in this question. Only the weakest made errors, the most common of which was to get put all ticks in the wrong columns.

(b) Only the most able could cope with the concepts in this question, with very few of these scoring more than one mark. Most wrote about polymers or fibres rather than chains or molecules. Many simply repeated the information given in the question. Few took note of the instruction to use ideas about the forces between polymer chains in their answer.

(c) Almost all candidates gained one mark. The idea that making these products required a different amount of energy was appreciated by only the more able.

4 Candidates struggled with the concept of sustainability in part (b). Many did not address the question as presented on the paper.

(a) Most candidates gained at least one mark, with many scoring both. Only the weakest candidates chose two of the distracters.

(b) This question asked how the sustainability of the two types of rope could be compared. Many weaker candidates simply compared their properties or discussed their uses. More able candidates gained marks by suggesting ideas of renewability or ease of disposal of the two ropes and explaining how these affected their sustainability. Others suggested additional information such as energy input or pollution caused during manufacture. Very few could put these ideas together in a coherent answer.

(c) Most candidates knew that a plasticizer would make the polymer more flexible. 'Increase the polymer chain length' was a commonly selected distracter for the less able.

5 Concepts involved in the nitrogen cycle are often poorly understood, and that was true in this question.

(a) Only the most able candidates had any understanding of the way that nitrates are formed as a result of the action of lightning, and few of these could put together both correct answers. Most candidates incorrectly thought that nitrogen and oxygen react to form nitrates which then dissolve in water.

(b) Most candidates correctly identified at least one of the elements, and the more able gave both phosphorus and potassium. Many weaker candidates chose three elements.

(c) The majority gained both marks in this question, with only a few of the least able not scoring a mark.

6 Many candidates had difficulty with simple recall of this area of the specification.

(a) Most candidates knew that hydrocarbons contain carbon and hydrogen, so gaining one mark. Only the most able could complete either of the other two rows correctly, and very few managed both. A wide variety of incorrect responses were seen.

(b) These three questions posed a major challenge to many candidates. In each only the more able gave the correct answer, with (iii) answered correctly a little more often than the other two. The most common incorrect answers were stomach instead of liver in (i), urine instead of urea in (ii) and bladder instead of kidney in (iii). A wide variety of other incorrect answers were seen.

(c) Many candidates succeeded in scoring 1 mark for linking additives to hyperactivity or allergies. Fewer referred to sugar or fat and those who did often linked both to the same health problem. Many weaker candidates mentioned more than one additive but did not say which of a selection of health problems these may cause. A number of candidates just made a list of additives then said that they could lead to 'health problems', which did not gain credit. Only the more able linked each of two different additives to a recognised associated health problem.

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

General Comments

The overall performance of candidates improved since last session.

In particular, candidates were good at identifying elements and compounds and the names of compounds and formulae (as in Q.1 (a)).

There were some positive responses to Q.6 (a) and many candidates understood that electrolysis involves the attraction of ions by electrodes and that ions move.

Candidates were less secure in identifying the differences between atomic structures of elements in the same group and frequently discussed reactivity and patterns in reactivity.

Many candidates misunderstood the questions which required them to link responses, such as Q.5 (c); if all the boxes were linked on both sides (six lines drawn instead of two), all marks were lost.

Comments on Individual Questions

1 (a) Was answered well by the majority of candidates; many achieved the full 2 marks. A few lost marks because they wrote "sodium chlorine" as opposed to "sodium chloride".

1 (b) Was answered reasonably well and most candidates were able to identify the correct response as chlorine gas having two atoms. There were a minority who lost the mark because they selected two responses, instead of just one box.

1 (c) Required the candidates to select two responses. Most were able to select that the regular arrangement of ions breaks down, but there was a large proportion of candidates who selected either ions getting smaller, or solid melting. Such candidates therefore clearly had misconceptions about the process of dissolving.

1 (d) Most candidates achieved at least one mark – usually for Br_2. The second mark was scored by a small majority, but common incorrect responses were linking "gas" instead of "liquid".

1 (e) Was answered well and it was obvious that candidates were able to deduce simple compounds given the reacting elements.

2 (a) Most candidates were able to select the correct symbol for caesium, and also the correct atomic number – only a few lost the mark because they gave the relative atomic mass.

The overwhelming majority of candidates struggled to gain marks on Q.2 (b). The question required responses about the differences in numbers of protons, neutrons and electrons and there was an expectation for candidates to state the numbers and be able to select these correctly. Although most made an attempt at the question, there was frequent misinterpretation and incorrect responses were given where candidates discussed changes in reactivity down the group. Where the outer shell was mentioned, some candidates wrote about "outside shell atoms" instead of electrons.

A few good responses were given – usually stating the differences in electron shell numbers.

2 (c) Was answered well; most candidates knew that they could use flame tests to look for lithium in compounds.

3 (a) Was answered correctly by most candidates who were clearly accustomed to naming compounds if given formulae. Parts (b) and (c) were answered poorly. A few were able to correctly select H^+ as the ion found in acids. There were few correct responses to part (b) where both $NaNO_3$ and K_3PO_4 were required for 1 mark. Few candidates recognised $Ca(OH)_2$ as an alkali used to neutralise acidic soils.

3 (d) (i) Also proved challenging for candidates; the correct response was ADEBC. Most candidates were able to select A and D, but then could not put the remaining options in the correct order.

Only a minority of candidates were able to recognise the equipment for titration in Q.3 (d) (ii).

4 Most candidates knew that a reaction starts fast and slows down for Q.4 (a). They were able to state that heating would increase the rate, and a large number of candidates were able to state that using smaller chips would also speed up the reaction, as would more concentrated acid. There were still candidates who failed to read the whole question and despite the rubric wrote about adding more acid or more chips. A few clearly understood changing rate, but lost marks because they only stated "change" temperature instead of "increasing it".

4 (c) Only required candidates to say that they would add universal indicator to the acid and then compare the colour to a pH chart, in order to gain both marks. Many candidates achieved a mark for colour change but failed to say that they would add the universal indicator. Some lost marks because they talked about different indicators or incorrect colour changes.

Most candidates collected at least one mark for Q.4 (d), usually for H_2O, but many were unable to identify calcium chloride.

Overall, candidates found parts of Q.5 challenging. Part (a) (i) was usually answered correctly, and there was an improvement in the recognition of different elements and compounds in Q.5 (b).

Few correct responses were given in parts (c) (i) and (c) (ii). Candidates needed to correctly link covalent with small molecules for oxygen, and covalent with atoms held together in a lattice for silicon dioxide. Many responses were random. In part (c) (iii) one mark was often gained, but rarely two.

Part (a) of Q.6 was answered well by some candidates, and it was obvious that Centres had completed practical work on electrolysis. Good responses included those where candidates had stated that lead ions were attracted to the negative electrode, and bromide ions to the positive electrode. It was clear that candidates knew that ions move, but some mixed up the charges and lost marks, or used the term "bromine" ions instead of "bromide" ions. A minority of candidates correctly selected bromine for the final response; often hydrogen was selected instead.

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

General Comments

The paper was generally well attempted. Few gaps or unattempted questions were seen in the objective style parts of the paper. The longer answers were less well attempted. Some candidates seemed underprepared for answering longer questions. Typically, single marks were scored where two or three marks were available. This was sometimes because candidates did not use the mark allocations as an indicator of how many clear marking points they needed to make. Many candidates left some or, in some cases, all of the longer answers blank.

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

1 (a) About three quarters of candidates correctly balanced the equation.

(b) There were five choices that candidates had to make to gain two marks. Candidates find true/false questions difficult because they need to make a decision on each line. Questions where they are told how many answers are true are more straightforward. In this question, most gained some credit, but less than a quarter of candidates classified all five statements correctly.

(c) In this question, candidates had to make a three-choice selection from five different ideas for three marks. Again, this is a very demanding type of objective question that candidates find very difficult. Most gained some marks, but only the most able knew all the changes that happen when an ionic compound dissolves.

(d) Candidates needed to make two correct selections to gain a single mark. Many made one correct selection, with the commonest incorrect answer being that the same compound is made.

2 (a) This question was an 'overlap' question in common with the foundation tier paper. It was designed to discriminate between grades C and D, and so should have been straightforward for most higher tier candidates. Candidates scored well, but few scored all four marks. The question asked about atomic structure. Some very good answers were seen, but many answers only talked about electron arrangement and did not discuss the differences between the nuclei of the atoms. Most knew that both have one electron in the outer shell.

(b) Almost all candidates recognised that a flame test would be used to discriminate between the two compounds, but not all realised that a spectrum would need to be looked at.

3 (a) Almost all correctly identified potassium sulfate from its formula.

(b) Most gained a mark for working out which two compounds gave all three elements.

(c) (i) Only just over half of the candidates knew that acids contain H^+ ions. OH^- ions were the common incorrect choice.

(c) (ii) Again, only just over half knew that calcium hydroxide was added to soil to neutralise acidity. Some candidates did not answer this question. Candidates should be reminded that it is good examination technique to make an educated guess for the objective type questions.

(d) (i) This was a difficult question, as the phosphate ion is unfamiliar, and candidates needed to work out its charge. The commonest incorrect choice was PO_4^{3+}.

(d) (ii) Almost half of candidates gave the correct formula for potassium nitrate. A formula with the charges of both ions shown was accepted, but not one in which only one charge was given. It was common to see the wrong number of potassium ions in the formula, for example K_3NO_3.

(e) Most identified at least one of the two compounds that react to form the salt.

4 (a) Answers to this part question were often confused with contradictory statements leading to a loss of marks. Some candidates did not refer to the rate of reaction (as the question asked) but instead described how the volume of gas changes (i.e. 'it goes up then levels off'). Some gave incorrect statements about the rate, such as saying 'it increases and then becomes constant'. Best answers referred to the rate decreasing and then stopping to gain both marks.

(b) There were two important ideas here. Firstly, candidates needed to read the graph to see that the rate for the second experiment was slower and that less gas was produced. Candidates who expressed either of these ideas were awarded one mark. Secondly, candidates needed to suggest how the conditions could have changed to give this pattern. The only change that would result in both a slower rate and less gas produced would be using a lower concentration of acid. Few candidates gained both of these marks.

(c) (i) Two thirds of candidates correctly calculated the Relative Formula Mass for calcium chloride. Where this mark was not scored, it was usually because of a small arithmetic error, for example giving 110.

(c) (ii) Even some candidates who did not score in (c) (ii) managed to correctly calculate the mass of carbon dioxide, leading to about two thirds of candidates gaining this mark.

(c) (iii) Candidates found this question difficult and few identified that the acid is the limiting factor. All distracters were chosen by the candidates.

5 (a) This was an easy mark for most higher tier candidates. Most knew that metals are only found in the Earth's crust and that non metals are found in both the crust and the air.

(b) (i) Both parts (i) and (ii) proved difficult for candidates. Most knew that oxygen contains small molecules but many were unsure about how the molecules were bonded together.

(b) (ii) There was confusion both about the type of bonding and the structure for silicon dioxide. This does not seem to be well known.

(b) (iii) Most gained at least one of the available marks for correctly selecting words to describe the properties of silicon dioxide. Some thought that it is a good conductor of electricity.

(c) Answers about elements and compounds were very confused, with about a third of candidates failing to score any marks at all. Most knew that compounds contain more than one element, but fewer gave the idea that the elements are bonded or joined together, so did not clearly distinguish a compound from a mixture. The explanations of elements were often too poorly worded to score, for example 'an element only contains that one element'. Some did not follow the instructions to 'give examples in your answer' and so lost the opportunity to score the easiest of the three marks.

6 (a) (i) Again, answers with many choices to make are difficult. About three quarters of candidates gained both marks. Some did not use the information to work out that 'aluminium is not soluble in sodium hydroxide' is an incorrect statement.

(a) (ii) Marks were lost here mainly due to the answers given being too vague for credit. Answers such as 'they harm the environment' or 'they cause pollution' were not awarded any marks. Better answers used the flow chart to identify the waste products and give specific points about their effect, for example 'sodium hydroxide makes water alkaline if it gets into rivers.'

(b) Ionic equations proved difficult for most candidates. Nearly two thirds did not score any marks, and there was a relatively high 'omit' rate for this question. Some were able to complete the equation for the formation of aluminium, but very few showed the formation of O_2 and 4 e^-.

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

General Comments

There were many candidates who performed well in aspects of this paper at Foundation level.

They responded to a challenge and only a few failed to include a response to every question. Centres had clearly encouraged candidates to attempt all questions.

As expected, there were some aspects of the paper that proved more challenging than others.

Candidates responded well to the question on lithium batteries and were able to relate knowledge of disposal to potential hazards and pollution. They were also good at describing how they would check the reactivity of Group 1 metals and how they would need to be stored.

Candidates were less certain about testing samples of products in Q 4(b), often referring to the testing of different batches as opposed to testing samples in the same batch.

Candidates were able to recognise hydrocarbons and draw structures, although they were less secure about the names of hydrocarbons, often writing butane instead of propane.

Many candidates failed to achieve any marks in Q.5 (a) (ii), where they were required to recognise that ethene comes from crude oil and therefore will run out.

Many candidates failed to achieve any marks in Q.5 (b), which required a response recognising that food prices would increase if there was competition in the use of feedstock in the manufacture of ethanol. Few candidates stated that method 3 "uses waste that would otherwise have no use", and just restated the stem of the question.

Comments on Individual Questions

1 (a) (i) Was answered extremely well by candidates, suggesting that centres had prepared them well for this question. Good responses were made and a vast majority were able to successfully link properties such as being 'lighter' with 'better performance'.

1 (a) (ii) Found candidates struggling to calculate the correct value of £4000. Many incorrect responses referred to "millions" of pounds which was not picked up by the candidates as being unrealistic.

Few candidates succeeded in gaining 2 marks for Q.1 (a) (iii), often only restating the numbers given in the question. Good responses included those that made a link between the fact that more lithium is required to make the larger car batteries. This question also required the idea that there would be a greater number of electrically charged cars in the future.

1 (b) Was answered really well. Candidates were able to explain the problems with extraction and disposal of lithium and its compounds. They were also clear in their descriptions of the necessity of using fossils fuels to make electricity to recharge batteries and that, in addition, there will be electricity used for extracting the lithium compounds.

1 (c) (i) and (ii) Many candidates lost marks because they confused the two questions. There was some understanding of electrolysis, but often candidates discussed negative ions being attracted to the positive electrode for part (c) (i) (instead of ions "moving apart") and then left the next question blank.

Most candidates were able to explain that lithium was reactive in Q.1 (d) (i) (although a minority were confused with lithium compounds and mentioned "toxicity"). They were less secure in its storage; good answers were those that stated "store in oil" or "place in a sealed container to keep water out" as opposed to "store carefully."

1 (e) There was some understanding that there were patterns in the reactivity of group 1 metals, but many candidates failed to describe how these would be tested, as opposed to just stating the change in reactivity, i.e. "the reactivity goes up as you go down the group".

Candidates responded well to Q.2 (a) and many achieved full marks. Many also performed well in Q.2 (b), achieving at least 3, and in many cases full, marks. There were few papers with errors such as missing elements or extra bonds, but the most commonly lost mark was in nomenclature of propane (often written as propene or butane).

Knowledge of combustion was less certain; few candidates scored both marks on the products of combustion, but the majority of candidates were able to identify an exothermic reaction.

3 Proved challenging for many of this year's candidates. Centres had clearly taught pupils about the reactions which resulted in esters, but candidates struggled to use the reactants given in order to produce a correct word equation. They were able to identify the reversible reaction symbol correctly, and a few correctly used the term "equilibrium."

A common mistake on Q.3 (d) was to include the same kinds of products made using esters e.g. perfumes and deodorants instead of plasticisers, perfumes or solvents.

4 Proved very difficult for many candidates. In part (a), about half of the candidates were able to cite that there may be damage to the kettle, or that too much phosphoric acid may be dangerous for using. However, the other half of the candidates gave vague responses about safety without qualifying their reasons. Good answers were those that gave some indication about quality control.

4 (b) (i) Most candidates achieved at least one mark, but few achieved the full 2 marks for the response CDEB. Very few candidates were able to give correct responses in part (b) (ii). This question required candidates to state that there may be outliers that could be discarded (stronger candidates were able to see this and responded well), and that also a mean could be calculated. Often candidates wrote about comparing different batches, which was not what was required.

Many candidates were aware of pH and colour change, but could not explain clearly how to achieve the end-point in neutralisation. Q.4 (b) (iii) required candidates to explain that indicators change colour and that this could then show when an acid was completely neutralised. Although colour changes were given, they were usually in the context of merely testing different solutions and not from the perspective of reaching an end-point.

Most candidates achieved at least one mark for the calculations in Q.4 (c) (usually for the first section) and there were very few candidates who did not

attempt these. The best responses showed clear calculations to support the final answers, but mistakes were common in the addition and multiplication of simple numbers; in part (iii), error carried forward enabled many candidates to gain some marks.

5 Required candidates to use information and previous knowledge to analyse different methods of producing ethanol. Overall, it was answered poorly. Many did select method 1 as using non-renewable starting materials but were unable to explain why for part (ii). This required candidates to state that ethene ultimately comes from crude oil, which is non-renewable as oil is running out, as opposed to just ethene being non-renewable.

Very few candidates gained any marks for part (b), which required candidates to say that in method 2 there is competition in the use of feedstock / corn / land for food and to make ethanol, and that method 3 uses feedstock / waste / biomass that would otherwise be thrown away / has no other uses.

6 (a) Few candidates could give a correct definition for a "fine" chemical, and few could correctly select aspirin. In part (b) (i) many candidates attempted the question and correctly wrote sulphur + oxygen → sulphur dioxide, but then many lost the mark because they added hydrogen as another product.

6 (b) (ii) Was answered well, and it was evident that candidates understood the purpose and definition of a catalyst. Few were able to explain how it works for part (b) (iii), however, and often discussed more frequent collisions as opposed to the lowering of activation energy and providing an alternative route for the reaction.

6 (c) Parts (i) and (ii) were both answered well; most candidates selected the correct responses as those stated by Amy and Jeff. They clearly understood what the term "analysis" meant in this investigation.

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

General Comments

The majority of candidates could extract simple ideas and information from the article. Most of the more able candidates were also able to use their knowledge and understanding to process information from the article and formulate acceptable answers to some of the more complex questions. But for many of the weaker candidates anything beyond finding and copying a relevant part of the article was too difficult. A number of the more able 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. There was, however, poor performance by many candidates in basic areas such as practical techniques and sustainability. Very few candidates could perform even quite simple 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

1 This question discriminated very well across the ability range. Many candidates lost marks by misinterpretation of the questions. The calculation proved to be a problem for all but the most able.

(a) Most of the more able candidates scored one mark, but very few scored both. Many weaker candidates quoted irrelevant parts of the article, often describing the merits of lithium-ion batteries rather than explaining why the demand for lithium might increase.

(b) A variety of correct answers were seen, the most common relating to the toxicity of lithium compounds and to the generation of electricity to charge the batteries. The majority of candidates gained both marks, with only the least able gaining none.

(c) In (i) most candidates realised that electricity has to be generated to charge the batteries of electric cars to gain one mark, but fewer related this to the emission of carbon dioxide to gain the second mark. Vague reference to pollution was not given credit.

In (ii) most candidates correctly suggested that renewable or zero-emission energy sources could be used to generate the electricity to power the cars, but fewer gave an example to gain the second mark. Many weaker candidates based answers on vague improvements to extraction or battery life, which did not gain credit.

(d) Only the most able made correct suggestions based on the relative reactivity of lithium and iron or lithium and carbon to gain the mark in (i). A very wide variety of incorrect answers were seen, mostly based on incorrect science.

In (ii) more able candidates were able to construct the cathode equation, but very few of these could give a correct anode equation. The majority had little idea of where to begin with either.

Most candidates scored at least one mark in (iii) by working out the relative formula mass of lithium chloride. Only the more able could then use this to calculate the mass of lithium produced.

50 x 42.5/7 = 304 tonnes

Many candidates wrote a mass of figures – added, multiplied and divided – to reach an incorrect answer.

2 The energy involved in bond breaking and formation was a source of confusion for many candidates.

(a) All four blanks were filled in correctly by most candidates and only the weakest gained less than three marks. The most common error was to give butane instead of propane. Often weaker candidates did not include all of the bond lines in the structural formulae.

(b) Most candidates balanced the equation correctly. The most common error was to put 10 molecules of oxygen instead of 5. Many weaker candidates entered numbers which seemed to have no relevance to the equation.

(c) The most common answer was along the lines of 'The energy used to break bonds is greater than the energy used to make bonds'. This gained one mark. Only the more able candidates included ideas of energy absorption for bond breaking and energy release for bond making, and fewer of these went on to compare the amount of energy involved in each. Some thought that more bonds were made than broken. Those who gave a complete answer usually did it in a clear and ordered manner to gain the QWC mark.

3 Only the more able performed well in this question, and very few of these could give a good explanation of how a dynamic equilibrium is established.

(a) Most candidates knew sulfuric acid is a catalyst for this reaction, and the majority of these went on to give more detail for the second mark. Only the weaker candidates suggested other roles such as dehydration or reaction with the alcohol to form the ester.

(b) Only the more able candidates included water as a product in their equation to gain this mark. Some weaker candidates changed the formulae that were given in the question in an attempt to balance an equation without water.

(c) The majority of candidates attempted to answer the question 'Explain what is meant by dynamic equilibrium'. Unfortunately the question on the paper asked for an explanation of how the reaction mixture reaches a state of equilibrium. The more able wrote that forward and backward reactions take place at the same time, or that they take place with the same rate, to gain one mark. Some suggested both to score two marks. Many candidates gave long answers that did not address the question. Some weaker candidates, perhaps using ideas gleaned from previous papers, ignored the context of the question and wrote about equilibria involved in the ionisation of acids or the distribution of solute between two solvents in chromatography.

4 Those who read questions carefully and considered their answers gained most from this question. Only a small number of the most able could perform well in the calculations.

(a) Many candidates misinterpreted this question as 'How can you make a titration accurate?' and generally scored no marks. Of those who answered the question as it was asked on the paper, the more able could put together a sequence of actions involved in a titration to gain a mark. Only the most able gave enough detail to gain both marks. Most of the weaker candidates gave answers that were both vague and confused. A common error was to put solid phosphoric acid in a burette. Some thought that the burette was filled with indicator. A number of candidates gave answers based on the purification of a product rather than a titration.

(b) A wide variety of correct answers were seen. Most were based on ideas of identifying outliers, calculating the mean or checking for consistency. The majority of candidates gained one mark, but few gained both. Incorrect answers often referred to accuracy. Despite the clear indication that these samples were from one batch, some candidates thought the samples enabled checking across batches.

(c) More able candidates gave correct answers based on the idea of looking at the range of results to see how close they are. A wide variety of incorrect answers were seen, including suggestions to carry out more titrations and to work out an average. Many simply said the results should be checked. Some candidates became confused over the term 'best estimate', thinking that this was a guess that could be improved upon.

(d) The majority of candidates gave one of the many credit-worthy answers to this question. Safety to consumers, effectiveness of product and correct labelling were commonly seen.

(e) More able candidates were able to calculate the correct mass of sodium hydroxide in (i).

25.0 x 60.0/1000 = 1.5 g

A wide variety of incorrect answers were seen, ranging from under a tenth of a gram to several thousand. The majority of candidates had little idea of how to proceed with the calculation and gained no marks.

In (ii) a large majority of candidates correctly calculated the relative formula mass of phosphoric acid to gain both marks.

(3x1) + 31 + (4x16) = 98

A common error was to include 3 x 31. The weakest candidates often made computation or addition errors.

Only a small number of very able candidates completed the calculation in (iii) correctly.

98 g H_3PO_4 reacts with 3x40 = 120 g NaOH

mass H_3PO_4 = 1.5 x 98/120 = 1.225 g

A common error was to use 40 instead of 120 for the mass of sodium hydroxide. These candidates could still gain two marks. Some candidates gained just one mark for relating 98 g H_3PO_4 to 120 g NaOH. Most had no idea of how to begin the

calculation. Commonly answers were a mass of numbers added, multiplied and divided to give an answer. Most incorrect calculations included 10 somewhere, usually multiplying or dividing another number.

5 State symbols were a stumbling block for many able candidates. Writing even a simple symbol equation was beyond most of the weaker candidates.

(a) In (i) more able candidates could write the symbol equation but few could correctly add the state symbols. Common errors for these candidates were using (s) for sulfur, (aq) for sulfur dioxide or (L) instead of (*l*). Weaker candidates often included H_2SO_4, H_2O or CO_2 in their equations.

In (ii) the majority suggested that vanadium oxide lowers the activation energy or provides an alternative route, but only the more able suggested both to gain the two marks. A common error was to suggest that it provided the activation energy.

(b) Good answers suggested that the regulations were for the protection of people and the environment. Many variations on this theme scored the two marks. Responses from weaker candidates were often too vague to gain credit.

6 Careful reading of the question was needed for answers to be framed correctly.

(a) In (i), most candidates realised that method 1 was least sustainable. Of these the majority could explain why, but fewer also said why methods 2 and 3 were more sustainable. A number of weaker candidates thought that either method 2 or method 3 was least sustainable.

In (ii) only the more able could suggest a sensible factor that may affect sustainability, with atom economy, by-products and energy input being the most common. Far fewer could say how this might affect sustainability. Despite the clear indication in the stem, many weaker candidates wrote answers based on feedstock availability.

(b) More able candidates generally realised that method 2 would involve competition with food supply, or that method 3 would not. Fewer could go on to explain the effect that this would have on food prices. Many weaker candidates did not understand what was required in the question.

A329/330 Principal Moderator's Report – Skills Assessment

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

General Comments:

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

The Skills Assessment component of each of the above specifications is weighted at 33% and it was still evident that some centres were not developing the underlying skills, knowledge and understanding of Ideas about Science in their candidates before an assessment took place.

Structure of the report

Vertical black lines in the margin throughout this report highlight important areas of concern, advice and guidance by the moderating team

This report is divided into the following sections

- Section 1: Administrative issues
  General comments
  Annotation
  Internal moderation
  Type and context of work of assessed work
  Nature of practical work
  Candidate helpsheets and teacher review of coursework
  Plagiarism
- Section 2: Assessment and marking framework
  Calculating the Strand mark
  Marking strands I and P in Data Analysis and Investigations
  OCR cover sheet for candidates' work
- Section 3: Data Analysis
- Section 4: Case Studies
- Section 5: Investigations
- Section 6: Final comment

Section 1: Administrative issues

General comments

Few Centres this year included details of how each of the tasks used for assessment had been introduced and presented to candidates. Those Centres that did not provide this information meant that on occasions moderators could not support the marks that were awarded by the Centre. This did lead to mark adjustments in some cases.

Annotation

Most candidates' work was annotated with the use of the assessment criteria codes eg I(b)6, at the appropriate point in candidates' work showing where the marks were awarded. However, in far too many cases the annotation was a very generous interpretation of the criteria and sometimes completely incorrect.

Internal moderation

Effective internal moderation ensures that candidates are placed in the appropriate order of merit. If the order is felt to be unsound because marking is inconsistent between different teachers the Centre may be required to provide further samples of work and possibly re-

mark the work of all their candidates. There were still too many incidences of unsatisfactory internal moderation reported by the moderating team this year.

Type and context of assessed work

Following guidance from the Joint Council for Qualifications (JCQ), coursework has to match both type (eg Data Analysis and Case Study or Investigation) and context (ie Biology, Chemistry or Physics) as appropriate for the specification concerned. Only a few Centres did not meet these requirements this year. As a reminder, if the same piece of coursework is submitted for more than one specification then it must be photocopied and put into the appropriate coursework sample package.

Nature of Practical work allowed for assessment

Coursework submitted for Data Analysis and Investigation must involve candidates having personal first hand experience of collecting data in a practical experiment. **Coursework which does not fulfil this requirement cannot be submitted for assessment.** Computer simulations or sole use of teacher demonstrations are not acceptable substitutes.

In the Investigation, marks awarded for Strategy (S) and Collecting Evidence (C) Strands must be based on an individual's contribution and not on a shared approach or shared class data or data from other secondary sources.

Candidate helpsheets and teacher review of coursework

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. **This is not acceptable practice**. The Joint Council for Qualifications (JCQ) have published appropriate guidelines and Centres are required to consult and abide by this http://www.jcq.org.uk/attachments/published/1260/14.%20Coursework%20ICC%201011.pdf

Teachers may review coursework before it is handed in for final assessment provided that advice remains at the general level. Having reviewed the candidate's coursework it is not acceptable for teachers to give, either to individual candidates or to groups, detailed advice as to how the work may be improved. Examples of unacceptable assistance include detailed indication of errors or omissions, advice on specific improvements needed to meet the criteria, the provision of outlines, paragraph or section headings, or writing frames specific to the coursework task(s).

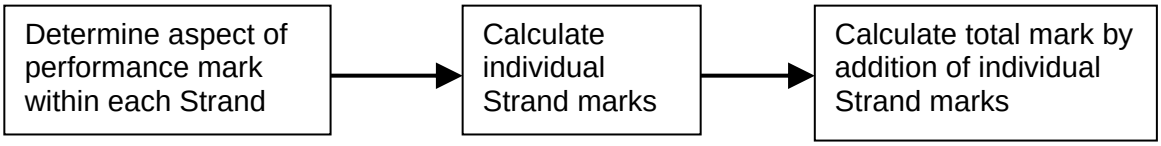
Candidate helpsheets of the generic type which are applicable to any task are allowed and whilst helpful for lower achieving candidates can restrict the opportunities for those higher achieving candidates. There was evidence that some Centres were providing helpsheets which rather than giving broad headings to guide their candidates were providing a very detailed breakdown of points and leading questions involving particular words or phrases in the mark descriptions which went beyond the spirit of teacher support and guidance. In these cases Centres sometimes awarded marks when candidates repeated the same words and phrases without demonstrating any understanding. Marks had to be adjusted in these situations.

Plagiarism

Quoting from the same JCQ document as previously mentioned, "Candidates must not copy published material and claim it as their own work. If candidates use the same wording as a published source, they must place quotation marks around the passage and state where it came from. "**Candidates must give detailed references even where they paraphrase the original material"**. There was evidence that in some cases, particularly in the Case Study, candidates were not following these procedures. "These actions constitute malpractice, for which a penalty (eg disqualification from the examination) will be applied".

Section 2: Assessment and marking framework

A significant number of Centres are still not following the correct procedure for calculating the Strand mark from the appropriate aspect of performance marks and are being required to re-mark all their candidates' work.



Determination of the Aspect of performance marks
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. Where performance significantly exceeds that required by one description, but does not sufficiently match the next higher one, the intermediate whole number mark should be given if available. Thus, the level of performance in each aspect is decided. 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.

Calculation of the Strand mark
(a) Three aspects of performance per Strand
Where there are three aspects per Strand the following examples illustrate how to convert aspects of performance marks into Strand marks. **Add the three aspect marks together, divide by three and round the answer to the nearest whole number.**

Example	Marks for the three aspects in a strand	Formula to be applied	Mark to be awarded for the strand
1	(a) = 4, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.66 round up = 4
2	(a) = 3, (b) = 4, (c) = 3	[(a)+(b)+(c)] / 3	= 3.33 round down = 3
3	(a) = 4, (b) = 3, (c) = 1	[(a)+(b)+(c)] / 3	= 2.66 round up = 3
4	(a) = 3, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	= 2.0 = 2
5	(a) = 2, (b) = 3, (c) = 0	[(a)+(b)+(c)] / 3	= 1.66 round up = 2

(b) Two aspects of performance per Strand (B and C of the Case Study)
From experience it is best to consider both strands B and C together when arriving at the final strand mark for each.

If **both** B and C average to (N + ½), then one should be rounded up and the other rounded down.
eg B(a)4(b)5 and C(a)5(b)6 then Strand B = 4 and C = 6 giving a total of 10 marks.

*If **either** B or C averages to a whole number (N) and the other to (N + ½), the ½ **could be rounded up or down on the basis of professional judgement***
eg B(a)4(b)6 Strand B = 5; C(a)5(b)6 Strand C = 5.5 which could be recorded as either 5 or 6 marks depending on judgement giving a total of 10 or 11 marks for these two strands taken together

Marking Strand I aspect (a)
This aspect involves awarding credit for processing the data which has been collected to display any patterns. This may be done either graphically or by numerical processing whichever is most appropriate in a particular Data Analysis or Investigation. If there is some evidence for both approaches, then both should be marked and **the better of the two recorded on the candidate coversheet but not both marks**.

Marking Strand P aspect (b)
The first row is concerned with recording quantitative data, the second row deals with the use of conventions and rules for showing units or for labelling in tables and the third row deals with the recording of qualitative data. Most investigations involve the collection and recording of quantitative information and in these cases, the aspect mark will be determined by averaging the mark in the first and second rows only, ignoring the third row completely. For those rare investigations which include qualitative evidence only, the mark for Aspect b should be based on the average of the second and third rows only. Where averaging results in half marks, professional judgement should be used to determine the best fit mark of the two alternatives. Once the mark for aspect (b) has been decided, it can be combined with the marks for (a) and (c) to provide the average and the mark for the strand.

For example, in an investigation providing **quantitative** evidence

Aspect of performance			**Strand P mark**
P(a)	7	7	**6**
P(b)	(i) 6 (ii) 4 (iii) n/a	5	
P(c)	7	7	

Candidate coversheet
All marks must be recorded on the OCR coversheet which is attached to candidates' work. A number of Centres did not use the latest format of the OCR cover sheet or in a very few cases did not use or fully complete a coversheet at all.

Section 3: Data Analysis

General comments

Centres are reminded that candidates must have personal firsthand experience of collecting data by performing a practical experiment. The data that they collect can be supplemented by further data from, for example, incorporating a class set of results. It is helpful if the data that is collected by the candidate themselves is clearly identified. **Work which is based purely on teacher demonstrations, computer simulations, given sets of results etc is not acceptable.**

It is most important that candidates record and present the data that they have collected and not just plot a graph or do numerical calculations without the inclusion of a data table in their report. It would also be helpful if candidates or teachers included the method that they used to collect data so that marks for E(b) could be more securely supported.

The same Strand I and E assessment criteria are used in investigations and the same marks for I and E from investigations can be submitted for Data Analysis in another specification **provided the subject context is appropriate for that specification**. If this is the case, Centres are required to indicate this on the appropriate coversheet and include appropriate photocopies of the work in both samples.

Data Analysis tasks.

There was a continuing variety of data tasks seen by moderators such as

Resistance of a wire	Stretching elastic bands, springs
Osmosis	Pendulum
Respiration of yeast	Cooling curves
Parachute drops	Clotting of milk
Crater impact	Bouncing of squash balls
Rates of reaction	Pulse rate and exercise
Effect of water depth on a 'tsunami'	

Centres are encouraged to be innovative but must consider the science that might be required to explain any conclusion drawn by the candidates. As in all assessments of this type, Centres should match the task to the ability and expectations of the candidates involved.

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', '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 repeat their measurements when performing practical tasks which is most encouraging. However, many candidates do 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 so that marks for E(b) can be awarded and that their conclusion maybe more clearly and confidently established gaining credit in both I(b) and E(c).

Strand I: Interpreting data

I(a): Most candidates analysed their data using bar charts or graphs to illustrate and process the data that they had collected rather than a numerical analysis. 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, using suitable scales and labelling axes correctly and 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 and more scrutiny is needed by Centres.

As a reminder the following guidelines provide more guidance about what is required but it is not intended to be comprehensive and to cover all eventualities.

- I(a) 4 – simple charts, bar charts
- I(a) 5 – a dot-to-dot graph or axes not labelled or incorrectly plotted point(s) or poor quality best fit line
- I(a) 6 – graph with correctly plotted points, correctly labelled and scaled axes and correctly drawn best fit line.
- I(a) 7/8 – **in addition to the requirements for 6 marks** candidates must show evidence of awareness of uncertainty in data eg range bars, scatter graphs.

If candidates use a numerical approach to analyse their data it is expected that candidates will be able to correctly calculate averages from repeat readings for 4 marks, do more complex calculations such as calculate percentage differences for 6 marks and for 8 marks calculate gradients from graphs or use simple statistical methods. Those candidates who have drawn a poor line of best fit on their graph but succeeded in calculating a gradient correctly may be awarded up to 5 or possibly 6 marks.

Some candidates included range bars when plotting bar charts and were wrongly awarded 8 marks. At best this approach might merit 5 marks. The same standards apply when marking computer-generated graphs ie they must be correctly sized and scaled with suitable grid shown and with the appropriately sized plotting points. However, it is generally better for candidates to hand draw their own best fit line.

Centres are reminded that only one single mark must be used for I(a), either that for graphical or that for numerical work but not both when determining the overall Strand I mark. Further information about the award of marks for numerical approaches is contained in the 2008 Report.

I(b): The match to I(b)4, 'identifying trends or general correlations in the data', was well appreciated and most candidates could summarise the patterns in their data with a suitable qualitative statement. However, candidates were often given 6 marks with little evidence to support this award. Many candidates referred to 'positive correlation' which only merits 4 marks. 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.

Very few candidates matched the requirements for I(b)8. Candidates should review any limitations to their conclusions by considering such things as the scatter in the data, overlapping range bars between data points, 'real differences' and values of the best estimate and can the best fit line be accurately defined. Candidates who have derived a quantitative relationship should consider what effect the position of the best fit line might have if the scatter in the data is taken into account.

I(c): Many candidates introduced their experiment by describing any related background theory even if it wasn't all relevant to the particular experiment they were doing. Candidates are better served if they link their conclusion directly with the appropriate scientific explanation that applies. 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. It is not just a few key words that must be considered but the actual meaning and correctness of a candidate's explanation of their conclusion that must be judged when arriving at the final mark.

Strand E: Evaluation

The majority of candidates achieved between 3 or 5 marks for this strand, showing improvement in E(a) and (b) but less so in E(c). Those candidates who used the appropriate IaS vocabulary and the knowledge and understanding of IaS 1 invariably achieved higher marks. 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.

E(a): The E(a)4 performance description is the 'gatekeeper' to access the higher marks. It requires candidates to identify any limitations or problems in their procedures that they encountered during their practical work. However, in many cases comments were limited to human error rather than systemic experimental ones. Candidates should then consider the limitations that they have identified and suggest suitable improvements to match E(a)6 and 8. A number of the suggestions made were not always of sufficient quality to be creditworthy eg 'do it with a computer' or 'repeat my measurements more times' without any justification or explanation.

E(b): The majority of candidates generally identified a data point as an outlier either in the table of results or on the graph 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 when discussing reliability and accuracy of their data. A limited number of candidates used more objective ways of assessing reliability and accuracy using simple statistics such as variations of the Q test procedure. Candidates' attempts to explain anomalous results were often generously marked and it is important to mark the **quality** of what has been written and not the fact that just **something** has been written.

E(c): Marks were often very generously awarded and this aspect still continues to be poorly addressed. This aspect involves bringing together the discussion about the reliability of the data collected and the procedure to establish a level of confidence in the conclusion. 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. Those candidates who had expressed a conclusion in quantitative terms had more opportunity to provide a more detailed analysis and evaluation to access the higher marks.

For the award of 6 marks, candidates should bring together a discussion of the accuracy and reliability of their data and the precision of the apparatus they have used to establish a level of confidence in their conclusion. Further support for this can come from awareness in I(b) about the limitations in the conclusion. In addition for 8 marks, weaknesses in the data should be identified eg a limited range or not enough readings at certain values, or degree of scatter too large or variable, and suggest in detail what more data could be collected to make the conclusions more secure for the particular variable under investigation.

Some candidates used other data from secondary sources to support or otherwise their conclusion. Some candidates recognised that their conclusion can only apply to the range of values that were studied because outside this range, for example, the rate is bound to slow down as one of the chemicals gets used up, the rubber band will eventually break, more exercise cannot always mean that pulse rate continues to increase.

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, such as 'peer review', 'replication of evidence', 'correlation and cause' 'reasons why scientists disagree', 'precautionary principle', 'ALARA', 'risks and benefits' found it much easier to match the performance descriptions of the criteria and gain higher marks.

Most candidates title their Case Study in terms of a question and collect appropriate evidence to illustrate both sides of a case. However, the analysis and evaluation of such evidence to derive a personal conclusion is still proving very demanding for the majority.

Many Centres provided a short list of appropriate Case Study titles for their candidates to choose from thus allowing them to select one which is the most appealing on an individual basis. It is important that titles for case studies do provide the necessary focus for candidates and don't just illicit a yes/no response but encourage a more thoughtful response with possible suggestions of future action. Those Centres who allow a more open selection of topic must closely monitor their candidates' choice to ensure that it is appropriate and firmly embedded in a scientific context with opportunities to gather evidence both 'for and against'. Surprisingly many candidates did not make full use of the relevant information and material in their student textbook often preferring to use only material from the internet.

A number of familiar examples were seen again this year but some such as 'Should smoking be banned in public places?' were seen much less frequently as their relevance diminishes.
Some examples of Case Study titles included this year –

- Should human cloning be allowed?
- Are mobile phones bad for your health?
- Is nuclear power the answer to our energy needs?
- Should we spend more developing alternative energy resources?
- Is the MMR jab safe?
- Is global warming natural or man-made?
- Is sunbathing safe?
- Does pollution from traffic cause asthma?
- What killed the dinosaurs?

The approach adopted by candidates who presented case studies on the following issues seemed to provide limited access to the higher levels of the assessment criteria.

- Is organic food best?
- Aspects of diet eg "Is obesity inherited?"
- Should animal testing be allowed?

Assessment

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. Those candidates who did not acknowledge their sources either when they copied and pasted information or when paraphrasing original material are guilty of malpractice and can incur a significant penalty. Those reports which were presented simply as PowerPoint printouts almost always lacked sufficient detail to access the higher marks.

Strand A: Quality of selection and use of information.
There was continuing evidence of improvement in the marks awarded for this strand compared to last year.

A(a): Candidates must select and use sources of information to provide evidence to support both sides of the argument in their case study. They must select relevant extracts to quote directly and then in their own words explain what its relevance and importance is to the developing arguments in the report. It was this latter aspect that only the very best candidates were able to show.

If no sources are credited then a maximum of 1 mark will be allowed by moderators. Higher marks require that sources represent a variety of different views or opinions and it is quality rather than quantity which separates the award of 2 or 3 marks. Many candidates who were awarded 4 marks incorrectly often made token reference to reliability but did not explain why they thought their sources were reliable. Those candidates who used the language and ideas from IaS 4 eg ideas about peer review, the nature of the source or the status of the author were much more likely to secure the top mark.

A(b): The majority of candidates included a bibliography of sources at the end of their reports. Candidates who identified their sources using incomplete references eg website homepages would be awarded 2 marks. If only one or two incomplete references are given then one mark should be awarded and if no references are given then zero marks. For 3 marks candidates included complete references to the exact url address of the webpage and when referencing books, the title, author and page references would be required. For 4 marks it is expected that candidates include some information about the nature, purpose or sponsorship of the site. It is also to be encouraged that candidates record the date when they accessed the information from an internet site.

A(c): Candidates were still not very good at clearly showing where sections of text were directly quoted. Use of quotation marks, use of a different font or colour highlighting, were some of the methods used by the better candidates. The better candidates also included references within the text to show the source of particular information or opinions quoting the specific author and then using, for example, numerical superscripts linking to detailed references in the bibliography. Credit is given, not so much for the quotation itself but for the comment made by the candidate to explain why it was chosen, and how the candidate thinks it contributes to the arguments being compared in the study.

Failure to discuss reliability of the sources, failure to fully indicate and reference quotations and failure to indicate the relevance of the quotations selected in the study prevented many candidates from being awarded 4 marks in this strand.

Strand B: quality of understanding of the Case.

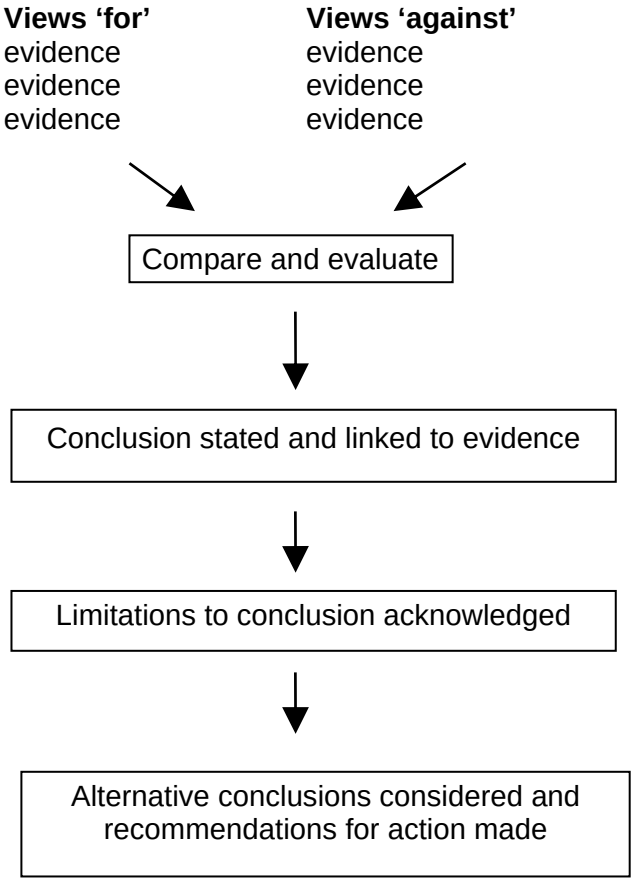
The majority of candidates described the relevant background science in the introduction to their case studies. However, it was only the most able who could integrate their scientific knowledge and understanding with the claims and opinions reported in their studies or extend the scientific knowledge 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. It is useful before marking candidates' work to look at the appropriate pages in the C21 textbook about Science Explanations and the Ideas about Science and also the published OCR exemplars to know in advance what material should be included. The most successful Case Studies are usually closely related to topics in the course and it can be taken as a general guide that 6 marks in B(a) requires all of the relevant science from the student book. The 7th or 8th mark will come either for applying and integrating this correctly to the case, or for finding and explaining some more additional science related to their Case Study.

Aspect B(b) focuses on candidates' ability to identify, report and evaluate the scientific evidence that any claims and opinions are based on. Most candidates were able to recognise and extract relevant scientific content from their sources and were awarded 4 marks. 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 look 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. For many 'life-science' studies, for example the popular MMR study, the evidence is largely drawn from epidemiological studies and good candidates should be looking for evidence of factors such as sample size, or how subjects were selected to evaluate the importance of the evidence. Even strong candidates tended to rely too much on summaries of conclusions rather than describing the evidence base.

Strand C: quality of conclusions

Strand B gives credit for the level and detail of the relevant science described and for reporting the associated evidence underpinning the various claims and opinions. Strand C awards credit for candidates who provide individual input comparing and evaluating the evidence and, using their own judgement, arrive at a suitable conclusion on a controversial issue. There was evidence that many candidates were not using and applying their Ideas about Science, particularly IaS 5, sufficiently to warrant the higher marks in this strand.

Those Centres who guided their candidates to organise their reports with the following headings in mind and to encourage them to develop their critical skills invariably achieved higher marks.



An approach adopted by a number of candidates this year was to copy and paste significant amounts of information from articles on both sides of the case. In most cases, the only comment added by the candidate was a short paragraph headed 'evaluation', but which was usually just a summary of the content. This warranted lower marks than centres had awarded.

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, many candidates referred to the evidence that they had gathered and were awarded 4 marks in C(b) whereas those who omitted any reference were limited to 2 marks. Better 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. Far too often the conclusion was limited and too brief. Alternative conclusions should be considered where appropriate and recommendations for action in the future should also be included. 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

D(a): The majority of reports included headings and/or sub-headings (2 marks) to provide the necessary structure. There was a definite improvement in this aspect and the better candidates included a table of contents and numbered the pages in their report (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.

D(b): Many candidates only included images which were decorative rather than informative and therefore failed to clarify difficult scientific ideas and improve effective communication. If there are no decorative or informative images included then zero marks is awarded. If one image is included, a decorative front cover or other low level attempt to add interest then one mark is appropriate. Two marks would be awarded for the inclusion of decorative images only or perhaps for the minimal use of informative images. Three marks would be given for including a variety of informative illustration eg charts, tables, graphs, or schematic diagrams and 4 marks if this is fully integrated into the text, referred to and used. Too often downloaded images from the internet were not clear, too small and not referred to in the text.

D(c): The assessment of the use of scientific terminology and the level of spelling, punctuation and grammar was generally very fairly assessed by Centres.

Section 5: Investigations

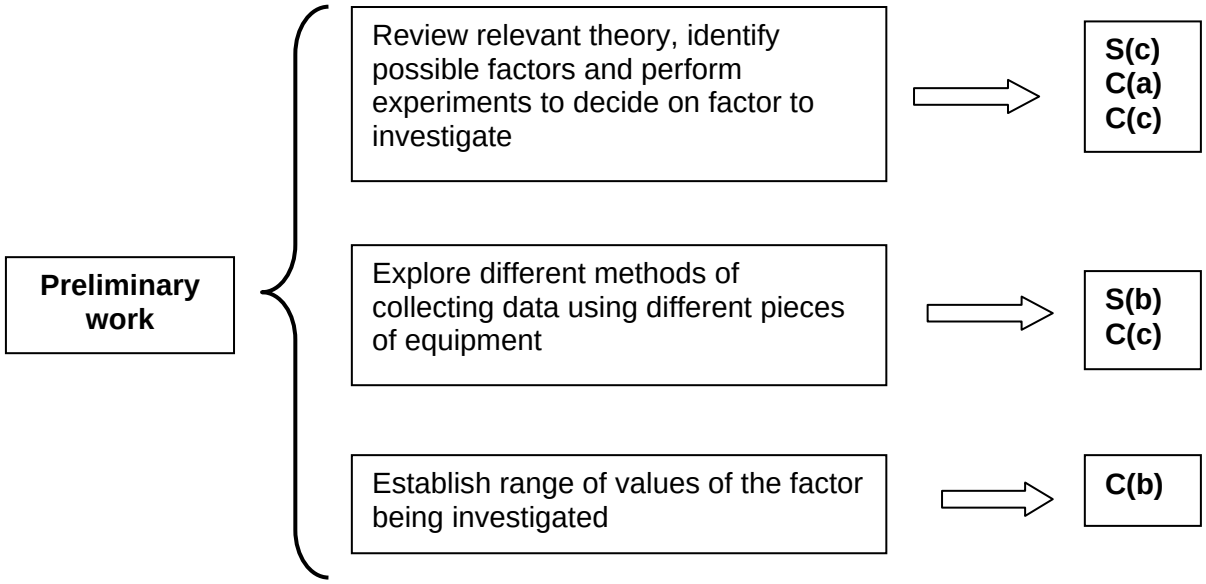
Rates of reaction, resistance of a wire and osmosis were still the most common investigations seen from Centres. However, there was evidence that other topics were being developed by more Centres who had gained confidence from previous years, for example, stretching of plastics and other materials, exercise and fitness routines, efficiency of wind turbines, objects rolling down slopes or ski jumps, electrolysis, investigations involving titration and electromagnets.

From an assessment point of view the 'performance descriptions' should be used to reflect the quality and performance of candidates' work rather than a formal/legalistic interpretation of particular words and phrases. There were a number of examples where credit had been incorrectly given for the inclusion of a key word or phrase but on reading the context in which it was written it was clear that the candidate had not understood or appreciated the correct meaning.

Strand S: Strategy

The importance of preliminary work cannot be over emphasised in the introductory phase of an investigation and the appropriate amount of time must be given to this aspect. Many Centres were clearly encouraging a more open ended exploratory approach and it is essential for

moderation if centres provide details of how the tasks were presented to candidates (eg copies of briefing sheets etc.)



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 necessitating a downward adjustment to the marks for S(c) in a number of Centres. Where candidates had been given the opportunity to show autonomy they performed well across many of the Strands.

It is important for candidates to record their preliminary data and to use it to inform and develop the main experiment. Often preliminary work appeared to provide just a limited extra set of results and did not shape the investigation in any way. Sometimes preliminary work was done but it was clear that candidates hadn't really understood why they were doing it.

Candidates should consider what factors or conditions might affect the results they will get. This will usually involve 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 will allow candidates to decide which factor it would be best to study and also provide evidence which can 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 they had been selected in preference to alternative equipment. Those candidates who exerted some choice over the apparatus they used were in a better position to achieve higher marks in S(b) and also when evaluating their procedures and methods in E(a). Candidates need to explore different methods and choose between different pieces of apparatus and adapt as appropriate to find the best way to collect good quality data C(c). Some candidates provided very simplistic justifications and Centres are reminded that it is **quality** of response in this context that is being rewarded. Many Centres provided a fixed, limited set of apparatus for candidates to use and this did not allow candidates the flexibility to try various approaches to obtain the best quality data set.

The complexity of a task, S(a), represents an overall judgement about the way a candidate has approached the task. Therefore two candidates doing the same investigation might approach it differently and therefore achieve different marks. Complexity depends on the demand and challenge involved in the approach adopted by the candidate and includes such indicators as the

familiarity of the activity and method, the skills involved in making observations or measurements, single or multi-step procedures, the nature of the factors which are varied, controlled or taken into account, the precision of the measurements made and the range, accuracy and reliability of the data collected. 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 by inspection of the results table could any evidence be found. Better candidates described in detail how the factors had been controlled and, even more importantly in some cases, monitored during the experiment. Weaker candidates often stated factors such as pH, surface area, current or temperature were kept the same but failed to explain how this was actually done or monitored. Often room temperature was mentioned as being the 'variable controlled' in rates of reaction or resistance investigations which was not the key 'temperature' variable involved.

Preliminary work is essential because if done properly it can allow access to marks of 7 or 8 in aspects (b) and (c). 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. Centres are reminded again that it is the quality of response and its relevance that is rewarded and not just that preliminary work has been done so 'jumping through hoops' is not sufficient criteria for success.

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. Plotting rough graphs as the data is collected may help candidates to identify outliers as they are collected which can contribute towards credit for E(b), towards defining the trend in the results more clearly, I(b), and for an improved level of confidence in the conclusion E(c).

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.

Many candidates still introduced their investigations with a significant amount of background theory which was not always relevant but more importantly was not used to explain the particular conclusion that the candidate had derived from the investigation. The C21 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) and detailed explanations using relevant scientific theory are best left until they are needed in Strand I.

Some candidates provided further comment about the confidence level E(c) in their conclusions in terms of how close the agreement was to their predictions using scientific theory. Some candidates whilst investigating the effect of length on the resistance of a wire plotted appropriate data and calculated resistivity and compared with data book values.

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. However, there appeared to be an increase in **errors in calculating the Strand marks for candidates** which resulted in considerable extra work for both moderators and centres (please consult the administrative issues section in this report).

There is further guidance about the interpretation and application of the assessment criteria and also illustrative coursework exemplars on the website www.ocr.org.uk. It is highly advisable that staff have time during the year for internal standardisation meetings to share and develop expertise in the Science Department.

The structure of case studies, data tasks and investigations has been modified in the new specifications for teaching from September this year, 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.

2011 Grade thresholds for Data Analysis and Case Study combined and Investigations for the different specifications.

	Grade threshold								
Component	**Max. mark**	**A***	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Data Analysis and Case Study	16 + 24 = 40								
Investigations	40								

Previous reports from 2008, 2009 and 2010 will still be available online at www.ocr.org.uk to provide further detailed guidance.

The grade thresholds have been decided on the basis of the coursework that was presented for award in June 2010. The threshold marks will not necessarily be the same in subsequent awards.

Some adjustments may be expected to maintain consistent standards across all the OCR Science specifications.

Geoff Mines (Principal Moderator) on behalf of the Moderating Team 13.7.11

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