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GCSE

Additional Science A
Twenty First Century Science

General Certificate of Secondary Education **J631**

Report on the Units

June 2008

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Oxford Cambridge and RSA Examinations

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

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

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A215/01 – Twenty First Century Additional Science A (B4, C4, P4) Foundation Tier

General Comments

The paper was generally well attempted. The mean mark was slightly down on June 2008, but this was probably due to the fact that many candidates took the examination in January and did not need to resit it.

Centres are reminded that questions on this paper are all objective style.

An overall impression is that candidates were generally clear about their subject knowledge.

Most candidates correctly followed the instructions in the questions and most made their responses appropriate to the number of marks available.

Candidates should be aware that marking is carried out online from scanned black-and-white images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously. To add additional lines or write comments such as 'please mark the pencil' or 'the blue lines are correct' make it difficult for the examiner.

Any marks that are ambiguous will **not** gain credit on this paper.

All candidates seemed to have made good use of their time. There was no evidence of candidates running out of time. A few weaker candidates did not complete the paper due to lack of knowledge, not lack of time. The number of 'No response' answers was very small indeed.

Comments on Individual Questions

1 Most candidates knew the hazard symbols well, but had difficulty interpreting the table of melting and boiling points.

2 Most candidates showed good understanding of the periodic table and scored well on this question.

3 This question examined a specification statement about the use of line spectra, but most candidates seemed to be guessing.

4 Having studied the Science unit, C3 *Food Matters*, many candidates could clearly relate the sodium in food to the information given on the labels. The two most informative labels proved difficult for many, however.

5 Calculation of speed was done well by all, and the difficult velocity-time graph was correctly identified by many.

6 & 7 Most candidates found the nature of forces and counter-forces difficult. Energy changes were clearer, but still often confused.

8 Candidates mostly had a clear understanding of homeostasis, but very few realised that, apart from sweating, water is lost by excretion and breathing – many confused 'breathing' and 'respiration'.

9 The action of bacteria in food was well understood by most candidates. However, the 'Talking Heads' part, choosing two correct explanations for why food cooked at high temperatures lasts longer, proved harder.

10 Most candidates clearly recalled that the experiment was on osmosis, but many did not visualise or remember what happens to the potato.

11 Most candidates had a good understanding of kidney function.

A215/02 – Twenty First Century Additional Science A (B4, C4, P4) Higher Tier

General Comments

The examination discriminated well. All candidates appeared to have time to complete the paper, and very few candidates were entered inappropriately for this tier. While the questions performed well overall, examiners noted that candidates found the biology areas to be harder than physics and chemistry.

Comments on Individual Questions

1 This question was common with the foundation tier paper.
The question was answered well. Most candidates realised that potassium chloride could replace salt because sodium and potassium are in the same group. Even those who got this question wrong tended to choose response A, so were clearly basing their choice on sensible criteria.
In part (b), the ordering of the beans in terms of useful information involved careful thought, but most candidates were still able to score two or three of the marks. Only a very small minority put the cans completely the wrong way round and so scored zero.

2 Most candidates realised that the combination of a flash and the dust on the Moon's surface could be used to identify elements in the dust.
Very able candidates also showed that they could handle negative melting points and boiling points in part (b); most other candidates chose -110ºC.
The structure of the unfamiliar xenon ion tended to be well answered, as was the linking of single positive ions to Group 1.
In question 2 (e), while many candidates identified the correct formula for lithium azide, there was evidence to suggest that some guesswork was involved.

3 This question was designed to be accessible to the most able candidates only, and appeared to be well answered by that target group. It was pleasing to see that the vast majority of candidates nevertheless attempted this question.

4 More able candidates showed themselves to be familiar with state symbols but, even though the stem of the question contained an example of a state symbol, many weaker candidates did not appear to recognise the term at all and so left this part blank.
The conductivity of ionic liquids is still a difficult topic for many candidates to deal with and so 4 (b) was well answered by the more able candidates only, other candidates tending to get this question wrong. It was encouraging to see that the most common incorrect response, linking particles in a lattice to vibrations, was still clearly based on good science.
Examiners flagged up to candidates that only one line was needed. They further emphasised this requirement by putting an instruction at the top of each column of boxes to 'choose one'. Candidates who did not heed this instruction were unable to gain credit. For example, some candidates connected all three pairs of boxes instead of the one pair that was required.

5 This question was common with the foundation tier paper.
The average speed of the car was generally well answered. Many candidates started by multiplying distance and time and ringed 4.5m/s as their first choice, but then changed their answer to the correct response,18m/s.
Many candidates correctly classified most of the true/false statements for 5 (b) (i) and scored one of the two marks. More able candidates scored both.
This question required a response to every statement, and the few candidates who left some of the boxes blank penalised themselves.
Many candidates correctly identified the velocity-time graph which showed the changing motion of the car. The most common incorrect response was graph A.

6 Weaker candidates found it difficult to decide how to calculate the time for which the force acted, but the true/false table in part (b) was well attempted, with many candidates scoring two of the three marks. Common mistakes were to say that the force from Sally's foot is *greater* than the force on the ball, and to say that it is in the *same* direction as the reaction force.
Most candidates were able to select the correct distance-time graph, with graph B being the most common alternative.

7 Almost all candidates clearly appreciated in part (a) that the reaction force would be vertical. However, only the able candidates realised that the force would be acting upwards rather than downwards.
While weaker candidates did not realise that the other half of the interaction pair was weight, they still went for the sensible wrong options of counter force and friction.
The sentence completion for part (b) was well attempted, with most candidates scoring at least one mark, but the calculation of the force proved to be much more difficult.

8 This question was common with the foundation tier paper.
Answers to part (a) showed that homeostasis was well understood. The most common incorrect answers were the second and fourth statements.
In part (b), candidates were told that a response may be used more than once, and able candidates were more prepared to use the word 'brain' twice and so scored well. Most candidates were able to gain one mark.
Part (c) was clearly seen as difficult. A large number of candidates identified excreting as one way of losing water from the body, but often stopped there. Another group of candidates focused on respiring and breathing but were not certain of the difference between them and so chose both.

9 More able candidates usually realised that sugar is the substance which is totally reabsorbed into the blood by the kidneys, though proteins, salt and water were all often chosen.
In part (b) candidates often showed several changes of mind before a final choice was made. The link between ADH secretion and urine concentration was recognised by the vast majority of candidates, although there was a lot of uncertainty over the exact direction of the feedback system. As in other questions, those incorrect responses often indicated clear familiarity with the basic ideas. Many candidates scored at least one mark, the most able generally scored both.
In part (c), the specific link between alcohol production and ADH tended to be better understood than the more general nature of the feedback loop, whereas in part (d), the effect of ecstasy was much less well known. Many candidates stated that ecstasy blocks, rather than increases, the production of ADH.

10 Interpreting the effects of osmosis is often difficult for candidates, and parts (a) and (b) of this question proved no exception. However, the majority of the more able candidates did understand what was going on and scored well. Examiners awarded the first mark if any one of the boxes was correct, and a large number of candidates were able to demonstrate this lower level of understanding.
In part (c), as in part (a), a large number of candidates were able to identify at least one correct statement about osmosis, but most found it difficult to identify both. The possible statements were designed to differentiate over a range of levels of understanding, and it was pleasing that 'The membrane blocks the movement of water molecules' was widely seen to be an incorrect response and so was rarely chosen.

A216/01 – Twenty First Century Additional Science A (B5, C5, P5) Foundation Tier

General Comments

The paper was well attempted and produced a reasonable mean mark.

Centres are reminded that questions on A216 are all objective in style.

Candidates should be aware that marking is carried out online from scanned black-and-white images of their scripts. Consequently, if candidates change their minds, any alterations must be made clearly and unambiguously. To add additional lines or write comments such as 'please mark the pencil' or 'the blue lines are correct' make it difficult for the examiner.

Any marks that are ambiguous will ***not*** gain credit on this paper.

The level of difficulty was appropriate for the ability range and all questions were accessible to candidates across the ability range. The majority of candidates generally performed well and marks were awarded across a wide range, demonstrating appropriate differentiation. Scores typically ranged from the high teens to the mid thirties (out of 42 marks).

Most candidates correctly followed the instructions in the questions and most made their responses appropriate to the number of marks available. Some, however, did not read the questions carefully enough.

Candidates should be reminded that use of a calculator is expected in this paper and that the 'useful relationships' at the front of the paper and the periodic table at the back can be used in answering the questions.

All candidates seemed to have made good use of their time.

There was no evidence of candidates running out of time.

Comments on Individual Questions

1 In part (a), most candidates knew that DNA is held in the nucleus, but very few could identify where protein is produced. Parts (b) and (c) were generally well answered, although some weaker candidates seemed confused by the statements in part (c). It is possible that they did not pick up on the fact that they were to select the wrong descriptions of differences between plants and animals, even though this was clearly stated in the question.

2 Very few candidates correctly identified stage C in part (a) of this question, although most knew that there are 23 chromosomes in human cells produced by meiosis. Most candidates incorrectly chose either 'doubles' or 'halves' for their answer to part (c). In part (d), many weaker candidates mixed up the last two rows of the table.

3 This question was well answered by almost all candidates. A significant minority of candidates incorrectly interpreted the rubric for (a) (ii). These candidates circled the answer in the list then tried to extend their choice by writing on the line below (e.g. 'Light' circled, 'food' written in the answer space below).

4 Very few candidates could correctly identify the lithosphere from the diagram given. Many candidates seemed to opt for choosing oxygen plus two more elements almost at random from the list provided in part (b). Factual knowledge directly from the specification will be examined as part of this paper.

5 In part (a) of the question most candidates could correctly match the name of each gas to its formula. Fewer were able to match the formula to the correct structure. Many candidates got confused by the diagram in part (b) (i), incorrectly selecting stage F as opposed to stage E as their answer. However, these same candidates often went on to pick up marks on the last part of this question.

6 This question was tackled well by all but the weakest candidates. Some tolerance was given with regard to the subscript numbers provided on the candidates answer to part (c), but candidates would be well advised that this may not be the case on future examination papers.

7 Most candidates could identify aluminium oxide as one of the two substances that can be electrolysed when melted. A significant number of candidates were distracted by the option 'silicon dioxide'.

8 Many good candidates showed evidence of calculations alongside their correct choice of answer in part (a). Although this is not expected, it was reassuring to see. There was evidence that some weaker candidates picked an answer at random here. Candidates should be reminded to make use of the 'useful relationships' sheet at the front of the paper. There was some lack of clarity over whether the component in part (b) should be treated as ohmic or non-ohmic in nature. As this difference would potentially affect the answer to part (b) and part (c), the mark scheme adopted a tolerant approach to account for any possible misunderstanding that might penalise candidates unfairly.

9 This question provided good differentiation across the ability range. More able candidates had few problems in part (a), but there was evidence that describing conductors and insulators in terms of free electrons was unfamiliar to some. Weaker candidates struggled in part (b) of this question.

10 Part (a) of this question was the only section of the paper with a significant 'No response' rate. Most candidates could not identify the LDR from the circuit diagram, most choosing the resistor instead. Almost all candidates could match the ammeter to its function correctly in part (b). However, far fewer could match the other two components to their respective functions. Only the more able candidates scored the mark for part (c).

A216/02 – Twenty First Century Additional Science A (B5, C5, P5) Higher Tier

General Comments

It was good to find that the vast majority of candidates entered for this paper were well matched to it. Some candidates managed to earn all of the marks and very few earned less than a quarter of them. Apart from 9 (a), candidates attempted all of the questions, suggesting that they understood what they had to do.

Most questions provided good differentiation, being correctly answered by the majority of strong candidates and only a minority of weak ones. In questions worth more than one mark, weaker candidates often selected obvious distracters with the consequence that they scored less marks than if they chose responses at random.

Centres need to be aware that candidates should take care when indicating their response. Poor handwriting or other failures to unambiguously identify their response can lead to a loss of marks. Candidates who change their mind should not be afraid to write a short sentence to supplement their crossings out - particularly where they have to ring the correct response.

Comments on Individual Questions

1 Only strong candidates could associate meiosis with egg formation, and say that the chromosome number remained unchanged in mitosis. The other parts of this question proved to be more straightforward.

2 Even strong candidates struggled to get the correct answer to part (a), with weak candidates often offering bases and amino acids in the wrong order. In part (c), candidates who got the first row incorrect rarely earned any marks at all.

3 All three parts of this question differentiated well, with strong candidates earning all of the marks and weak candidates almost none.

4 This was the first of the chemistry questions. The majority of strong candidates had no difficulty in identifying E as the correct stage for (a), but weak candidates often selected F instead. In part (b), almost all candidates earned the mark. Parts (c) and (d) proved to be more demanding, but it was good to find that even half of the weak candidates could balance the equation correctly.

5 Although biosphere was a very popular incorrect response, most candidates were able to correctly select lithosphere for part (a). The majority of candidates across the whole ability range identified aluminium oxide for (b), but too many opted for silicon dioxide instead of sodium chloride as their second choice. Parts (c) and (d) proved to be more demanding. Most candidates struggled to earn the mark for (e); having selected copper, they seemingly chose others at random. Only half of the strong candidates opted for zinc as their second choice. They fared better with balancing the equation in part (f).

6 Part (a) was the easiest question of the whole paper. Almost no candidate failed to earn the mark. Part (b) was, as expected, much harder, but still accessible to strong candidates.

7 This was the first physics question of the paper. The majority of all candidates had no difficulty in calculating the power for (a) or identifying the correct terms for (b). The mark scheme for (c) was broadened to accommodate candidates who might reasonably expect that the increase of temperature of (b) would affect the resistance, so graphs A or D were accepted as correct responses.

8 All three parts of this question were well answered by most candidates, with weak candidates earning about half marks overall. Part (b) proved to be hardest, with many candidates opting for 230/5 instead of 230 x 5. This suggests over-confidence, as the formula is listed on the second page of the exam paper. Perhaps centres should encourage candidates to always check the correctness of a formula, rather than trust their memory and get it confused with R = V/I.

9 Part (a) was not attempted by many candidates. Those who did have a go either put a voltmeter in series, an ammeter in parallel or just used the wrong symbol - a circle with M in it was a popular incorrect symbol. However, most strong candidates earned the mark. In part (b), few candidates earned both marks suggesting that only a minority have any understanding of cause and effect in an electrical circuit. It was good to find in (c) that most candidates knew that voltages add up round a series circuit. As expected, only strong candidates knew that inserting a second cell in parallel made no difference to the circuit.

A217/01 – Twenty First Century Additional Science A (B6, C6, P6) Foundation Tier

General Comments

This was the first time that this paper had been sat by candidates in June and it was pleasing to see how well the vast majority of candidates had been prepared for the examination. Most candidates followed the instruction and answered the questions in the correct manner. However when an alternative method of answering was provided, credit was given if the examiner was sure that the candidate knew the correct response.

Comments on Individual Questions

1 (a) Only more able candidates gave the correct response of speed, with the majority giving the wrong answer as frequency.
(b) Most candidates identified A as the correct answer.
(c) Most candidates were credited with at least one mark on this question and wrote clearly enough for examiners to identify the T from the F. However all candidates would be well advised to write clearly in these circumstances.
(d) This proved to be a more taxing question with only the most able scoring the single mark. The most common incorrect response was A.

2 (a) This question required two responses. Some candidates failed to appreciate this and consequently lost the opportunity to score one of the marks. Only the most able correctly identified the two correct responses.
(b) This question was answered surprisingly well, with a large proportion of candidates scoring both marks.

3 (a) This question was not well answered with only the most able identifying the two correct responses of 0 and 1.
(b) This was better answered with the vast majority of candidates scoring at least one mark.
(c) This proved to be a difficult question with only the most able scoring. The most common error was that candidates thought that the waves were both strongly absorbed by air.

4 (a) Most candidates correctly identified the cerebral cortex as the correct answer.
(b) Most candidates scored at least one of the two marks. Some candidates copied the text from the answer box and wrote it next to the letter in the diagram. If the position of the text was correct, credit was given.
(c) Most candidates scored this mark and where no credit was given, it was usually due to the fact that only one response was given. Candidates need to read the question carefully to avoid this error in the future.

5 (a) Most candidates scored two marks on this question. The most common correct response was the fatty sheath; transposing axon and neuron was the most common error.
(b) Most candidates correctly identified insulation as being the correct answer.
(c) Only the most able candidates managed to score both marks on this question. Those candidates who wrote in the text rather than the letters were credited with a correct response.

6 (a) This proved an easy start to this question with most candidates giving a correct response.
(b) This proved to be a good discriminator with only the most able candidates scoring both marks. Tropisms, a plant response, was a surprising incorrect response that was often given.
(c) Candidates were allowed one error on this question before losing either of the two marks. Consequently most candidates were able to score one or two marks.

7 The majority of candidates scored either one or two marks, with only the most able scoring all three.

8 Hardly any candidates scored full marks on this question. This was possibly due to the fact that candidates missed the clue that the first lines were to the 'changes' i.e. more than one, and only drew one of the lines. The error was further compounded by those candidates who drew two lines on the right hand side when the question clued them in to there being only one change.

9 (a) This question was answered well with most candidates scoring full marks.
(b) This question was not answered well. Most candidates simply guessed at the correct response and consequently failed to score.

10 (a) Very few candidates scored this mark. It was clear that this was one area of the specification that they had not learnt.
(b) The correct response of Brenda was given by most of the candidates.
(c) This question was not answered well with candidates simply trying to guess the correct response.
(d) This question was also not answered well with candidates simply trying to guess the correct response. Candidates need to spend more time learning this area of the specification.

A217/02 – Twenty First Century Additional Science A (B6, C6, P6) Higher Tier

General Comments

The paper appeared to be generally accessible to many candidates. Very few attempted to use forms of response other than those directed within the rubric of the paper and even fewer provided answers in inappropriate locations on their scripts. With an overall spread of marks from 0 to 42 (out of 42 maximum), it is clear that the content of the paper was not too easy or too challenging for most candidates. Candidates were clearly well prepared for this objective style of paper. Very few candidates failed to respond to items and most were able to determine the correct number of responses required within each item. The paper was well done by most, with fewer than 21% of candidates getting less than 22 marks out of the 42 available on this paper and approximately half scoring more than 26.

Comments on Individual Questions

1 (a) This question was in common with the foundation tier. The majority of candidates responded well to this item. Most were able to recall that sound waves are not absorbed by the atmosphere and are able to travel through empty space.

(b) Most candidates successfully completed the name of the process 'modulation'. However, some were uncertain about the alteration of amplitude and frequency with reference to putting information into radio waves. Some confused speed with frequency.

2 (a) Although the majority of candidates appreciated that the light was refracted through the prism, some were distracted by the other options provided. No clear pattern emerged in respect of the alternatives chosen.

(b) This item proved to be somewhat challenging for a number of candidates. Although some candidates obtained full marks and understood the process of light entering the glass prism, others were either confused by this concept or were uneasy about repeating one of the options, i.e. 'decreases'. The stem of the question did state that words may be 'used once, more than once or not at all'.

(c) The diversity of responses presented for this item indicated a level of uncertainty. Some candidates did not appear to use the diagram to help them to determine the correct response, i.e. light is reflected because the angle of refraction would be greater than 90°.

3 (a) Many candidates demonstrated a good understanding of mobile phone technology. The sequence of stages enabled the candidates to determine the correct order, particularly since the final stage was provided. Candidates appear to cope well with such sequence items. A number of candidates obtained one mark because of one sequencing error. No clear pattern emerged for the alternative responses. Only one combination of letters led to 0 marks, unless candidates failed to complete all three boxes. Almost all candidates attempted to complete the boxes.

(b) The reference to letter 'D' as the measure of amplitude was based on factual recall. Although some candidates were able to interpret the disturbance-distance graph correctly, many did not cope well with this item. A clear pattern of alternatives was not determined but candidates tended not to choose letter 'B' on the graph.

3 (c) A number of candidates were able to use the options to explain why digital transmission of sound with radio waves is of higher quality than analogue transmission. This was a challenging item for many candidates; many obtained one mark because they recognised that the digital signal can be separated from noise in a radio signal.

4 (a) This question was in common with the foundation tier and many candidates found this item to be accessible. They were able to distinguish between the snail and humans in relation to complex versus simple reflexes and their type of behaviour. A relatively small number of candidates were confused with the concept and included unrelated responses such as 'tropisms'. Such candidates appeared to be guessing.

(b) Although this item seemed to be challenging, many candidates were awarded full marks. They were allowed to carry one error within their responses and to be allocated 2 marks. Surprisingly, some candidates did not understand that muscle cells were effectors. A number of candidates obtained 1 mark because they identified light-sensitive cells as receptors and were able to distinguish the nature of at least one other type of cell in the table.

5 (a) This proved to be difficult for many candidates. Although candidates frequently identified the first three stages in the model (A, C and F), they struggled with the remaining set. Some candidates correctly identified 'information rehearsed' as stage E, possibly because of the curved arrow in the model, but were not sure about the two remaining stages (B and D).

(b) Most candidates were able to identify the significance of repetition of information in the learning process. However, a number were confused with the 'pattern' of information and the association with a specific feature, in this case 'smell'. This is a challenging topic for candidates to recall.

(c) Almost all candidates understood that the cerebral cortex is the processing centre for memories. Relatively few chose one of the other options. No clear pattern emerged with respect to the alternatives selected.

(d) This item was accessible to most candidates. They were able to recognise the correct features of neuron pathways in the brain and therefore disregard the wrong description, i.e. neuron pathways no longer function.

6 (a) Not all candidates appreciated that synapses slow down the transmission of impulses, although the model demonstrated the complex series of stages taking place at a synapse. A number of candidates did, however, recognise that synapses only allow impulses to travel in one direction. It was surprising to observe that some candidates considered that increasing the gap in a synapse speeds up the transmission of impulses (the incorrect, final option).

(b) Many candidates were able to cope with this item. They realised that serotonin levels would increase since ecstasy blocks the action of the receptor molecules, thereby preventing the eventual breakdown of serotonin in the synaptic cleft. Some may have simply made the link between the 'feeling of well-being' and the presence of more serotonin.

7 (a) This question was in common with the foundation tier. Many candidates failed to recall that tartaric acid is the solid acid used to make baking powder. A number of candidates selected one of the other three acids listed, in no particular pattern, but almost all avoided the hydrogen chloride option.

(b) Many responses were correct. Brenda's suggestion for the acid and alkali dissolving in water was recognised as the most reasonable explanation for the reaction of baking powder in water. None of the other options referred to water.

(c) Very few candidates selected the correct response. No clear pattern emerged in relation to the other options chosen but many did consider that H is produced when acid dissolves in water.

7 (d) Again, few candidates selected the correct response. A number considered that the nitrogen option represented the gas released when metals react with acids. Some candidates, however, did give correct responses to both this item and item (c). If they were correct with one, they tended to be correct with the next response.

8 (a) Many candidates were able to analyse the graph in the correct way. They appreciated that the more active the catalyst, the lower the levels of pollutants released by the car. The candidates seemed to have a good understanding of this inverse correlation.

(b) This item was generally answered with some difficulty. Relatively few candidates followed the stem of the question and instruction statement correctly. They chose to draw three lines, rather than the single line requested. This prevented them from obtaining the mark because, even though they may have correctly drawn the line between the increased rate of reaction and the increased conversion rate into harmless gas, they gave alternative lines. Under such conditions, it is not possible to determine the response intended by the candidate.

9 Many candidates were able to answer this item correctly. They understood that when completing a titration for acid-alkali, the colour change should be sudden. This understanding was not shared by all candidates and a number of options were observed. One of the most common alternatives was that provided by 'Bron', who suggested that a range of colour changes would be seen. Although this was an understandable choice, it is incorrect.

10 (a) Many candidates did not cope well with this item and also the following item. Some did respond correctly and identified option B as the equation which was not balanced. The word 'not' was emboldened to ensure that candidates focused on this approach. For those who did obtain a mark for this item, they tended to do the same for item (b). There did not appear to be a clear pattern of alternative responses from other candidates.

(b) As for item (a), many candidates failed to respond correctly. This item was based on factual recall but many were challenged by the equations presented. No clear pattern emerged in relation to the alternative choices selected.

(c) Most candidates did not complete this item correctly. They appeared to be unaware of state symbols or were confused by the scenario given in the stem. Some did attempt to give state symbols but used upper case, rather than lower case, letters.

A218/01 – Twenty First Century Additional Science A (Ideas in Context) Foundation Tier

General Comments

The examination discriminated well, all candidates appeared to have time to complete the paper, and candidates tended to be entered appropriately for this tier. While the questions performed well overall, examiners noted that candidates found the biology areas to be harder than physics and chemistry.

Unlike other Twenty First Century Science papers, there was a noticeable tendency for some candidates not to attempt all parts of every question, especially in question 3 and so ruled out the possibility of gaining credit in those areas. Examiners have noticed in the past that those candidates who attempt every question, even when they are convinced that they do not know the answer, invariably score better than candidates of similar ability who leave blank spaces.

Examiners are aware that candidates are reading the question when under pressure, so key words are often emboldened to prevent simple reading errors. It is worth reminding candidates to be on the lookout for such emboldened words, and perhaps to mark them up with a highlighter pen before reading each question.

Comments on Individual Questions

1 Most candidates gained full credit for explaining how salt crystals form and also why the amounts varied throughout the year. In some cases, so much material was copied from the pre-release document that examiners did wonder quite how specific that understanding really was, but were prepared to give benefit of doubt on this occasion.
Many candidates were able to name a salt that would be formed on evaporation, though weaker candidates often suggested substances such as magnesium sulfide, carbon sulfate, or just gave the name of an ion on its own.
Part (b) worked very well as a question. The majority of candidates could write a word equation for the precipitation of calcium carbonate, with the small minority who did not appreciate what was happening giving more random answers.
Able candidates described both the arrangement of ions in a solid and their lack of movement for part (c). Most other candidates were able to say something about the movement of the ions. For the arrangement mark, examiners were looking for an indication of the *regularity* of the arrangement of ions. Responses such as 'a *fixed* arrangement' were seen as statements about lack of change rather than about the nature of the arrangement itself. Weaker candidates sometimes left this section blank.
Candidates did not find it easy to link electrical conductivity in a solution to the movement of charged particles in part (d) (i) and a significant minority left it blank. The most common misconception was to assume that metal compounds made good conductors because metals themselves conduct electricity.
Many candidates could suggest the use of universal indicator as a method for testing pH, though a second method of testing pH was not well known and only a few could suggest a pH meter. As the question was asking for techniques which could be used on a solution of unspecified pH, answers involving the use of litmus could not gain credit. Another common incorrect suggestion was the use of iodine. Examiners were very forgiving of imprecisely worded responses, but some answers were so vague that credit could not be given. As the question was asking for techniques which could be used on a solution of unspecified pH, answers suggesting the use of litmus could not gain credit. A small minority of candidates did not even attempt the question.

Many candidates appreciated that the alkaline lake water would be pH = 10. The most commonly chosen distractor was pH = 7.
Almost all candidates suggested at least one, and usually several, suitable safety precautions. A few gave very general responses such as 'use safety gear'. These were the exception rather than the norm and did not gain credit.

2 Almost all candidates were aware that the collision with the bendy lamp posts would take longer for part (a) (i).
The pattern of the graph in part (a) (ii) was well attempted. As examiners were looking for the ability to link the changes in the two variables they ignored any incorrect causality. Consequently, answers such as 'a big force causes a short collision' were given credit for correctly linking the sizes of the variables. However, some candidates had difficulty in phrasing their answer, and responses such as 'the force slows down' were not given credit.
The safety features built into a car were well understood. Examiners were tolerant of 'crumble zones' though this did give cause for a smile.
In part (b), candidates were required to analyse a more complex piece of text. The most able candidates were clearly able to do this and scored well. Weaker candidates often selected the wrong type of lamp post to write about.
Many candidates showed weaknesses in their concept of energy for part (c). 'Momentum' and 'gravitational potential energy' were often suggested as names for the energy of motion, and candidates also forgot about conservation of energy, suggesting that the total energy in the collision decreased. Possibly many candidates did not realise that the question was about 'total energy', despite the fact that the word 'total' had been emboldened.
Most candidates were able to select the equation for momentum from the front of the paper for part (d) (i), though many went no further than to state the equation. However, weaker candidates showed uncertainty about what was needed and gave two equations. Examiners still allowed credit if both the equations involved momentum, but if it did not they had no choice but to penalise the answer.
Part (d) (ii) showed a huge contrast between ability on an objective style paper and on a more free response. When given possible alternatives, candidates are clearly comfortable with the idea of pairs of forces. However, without the cueing of the range of possible alternatives, the task was seen to be much harder.

3 The more able candidates were able to state that the stimulus described in the article was that of low oxygen levels in the blood. 'Serotonin' was the most common incorrect response. Candidates of average ability did, however, go on to get the mark in part (a) (ii) for 'gasping'.
In part (b) (i) examiners were looking for an advantage of a reflex being involuntary, hence that word was emboldened. Able candidates did address that point and so were able to gain credit. In (b) (ii) candidates clearly had a good understanding of reflexes in babies, and a wide range of suitable involuntary reflexes was given.
In part (c), most candidates could state that the babies which died of SIDS tended to have more neurons and fewer receptors. The more able then linked these to serotonin.
Many candidates appeared to be unfamiliar with the terms synapse and cerebral cortex, so found it difficult to answer parts (d) and (e), and sometimes left that part blank. Common responses for the functions of the cerebral cortex were the control of blood pressure and of breathing.
The final question on the paper, on the reasons why the evidence might not be conclusive, was much better attempted with many candidates scoring at least one mark.

A218/02 – Twenty First Century Additional Science A (Ideas in Context) Higher Tier

General Comments

This is the first session that this paper has been taken by candidates. As with any new assessment, it takes time for teachers to become skilled at preparing candidates for such a different paper. The performance of candidates was disappointing across all three units assessed (Q1 assessed ideas in C5, Q2 ideas in P4 and Q3 ideas in B6). This appears to be because candidates had not prepared themselves by using the pre-release material fully.

Each question in this 'Ideas in Context' paper assesses ideas in a single unit of the specification (three in all). It is intended that candidates and their teachers use the pre-release material to identify the three units and then revise the ideas in those units. It is expected that teachers support candidates in preparation for the examination by using the pre-release material in lesson time to revise the unit with them. This year, the key ideas were ions and ionic salts in solution (C5), forces and motion (P4) and the function of neurons (B6).

It was common that the longer answer questions, with 2 or 3 marks, often generated only partial scores of 1 or 2. This was for two reasons. Firstly, the candidates do not generally use scientific terms very fluently, so, for example a mark could be awarded when talking about why ionic compounds conduct electricity if they had written 'ions are charged' but not 'ionic compounds are charged'. The loose use of language was a common reason for poorer scores. Also, weaker candidates do not always make enough points, e.g. making sure that they make three clear points if the mark for the question is given as 3.

The questions on the higher tier paper are designed to be challenging enough to discriminate between grades up to A*. Candidates who are towards the weaker end of a C performance would be better served entering the foundation tier paper, where the questions would enable them to show their best performance.

Comments on Individual Questions

1 This question was about ionic compounds. It covered chemistry found in unit C5. Candidates did not know ionic bonding well enough to score appropriately.

(a) There were two reasons that candidates lost marks here. Many confused the state symbols (aq) and (l). Secondly, many did not write formulae properly. The O and the C in the carbonate should be shown similar sizes. $CaCo_3$ was not given credit.

(b This question asks the candidates for a straightforward comparison of movement and arrangement of ions. Many discussed that the ions are 'closer together rather than far apart' implying a limited knowledge of ionic structures. Most knew that there was less movement in the solid form, but fewer discussed the orderly or regular arrangement of the ions.

(c) The mark scheme looked for an understanding that, in solution, ions are charged and can move. Common errors included a discussion of electrons moving, and also talking about whole compounds having charges or moving. Answers such as 'the salts can move about' or 'the compounds carry charges' did not score.

(d) This was a more challenging question. Some candidates answered well, but some lost a mark by only talking about one, rather than both ions. Therefore 'Mg has a +2 charge' is only a partial answer as it does not make a comparison with Na.

(e) Candidates needed to analyse the text to work out the similarities and differences between the two types of water. Most realised that the ions were similar but that the quantities of salts in each may have varied. A common incorrect answer was to talk about there being 'more water in the lake' implying that they were comparing a large lake with a small bucket.

2 This question was about force and motion (P4). Again, many candidates did not seem to know the key concepts necessary to tackle these challenging, higher tier questions.

(a) Candidates are provided with a formula list at the beginning of the paper. Most used this well, to identify the correct formula. The communication mark was awarded if the candidate had described the relationship in words, rather than merely writing down the formula. In (ii), few realised that the action of the opposing force would affect the lamppost in some way.

(b) This was an interesting question, in that it revealed partial understanding about the ideas in the pre-release material. The information told candidates that the lamppost works by prolonging the collision time and this graph shows the outcome of this on the force acting. Many good answers were seen here, some even discussed rate of change of momentum (a very high level understanding). However, some tried to describe the graph shape without relating this to the context. Hence, answers such as 'the collision time goes down as the force goes up' were not given any credit.

(c) Three different tasks were demanded here. Most candidates understood that the graph would be horizontal at first and then would drop, but fewer showed a sharp fall to the correct point (20). Many 'rounded' the corners or showed the speed gradually decelerating during the collision. The last part of the graph, the car slowing to a stop was particularly poorly done. Many drew a downward curve that hit the horizontal axis too early and then ran along it, or showed the car decelerating slowly with a vertical line down at the point of the collision. This would be a good practice to use when teaching this area.

(d) The calculation was intentionally very challenging. Many found the correct formula to use but either failed to substitute into it correctly or failed to re-arrange it. Taking the square root proved too challenging for all but the most able candidates. Some candidates who had successfully reached the end lost a mark at the final post by incorrectly rounding their answers, e.g. 5.48 is correct, 5.47 is not.

3 This question proved to be the most difficult of the three. The brain and mind concepts in B6 are very challenging, and are new areas for study at GCSE. Questions about nerve impulse transmission across synapses will occur commonly on the papers, and this would be a good homework question to give to more able students.

(a) Most did not know the functions of the cerebral cortex. Many discussed sense or movement.

(b) This part question asked about the conclusive nature of evidence. Candidates were on secure ground here, and most scored at least one mark for making clear points about the nature of the sample choice or its size.

(c) Part (i) involved extracting information from the article to realise that SIDs babies have fewer receptors. This was well answered. Part (ii) asked for a description of the mechanism of transfer of the nerve impulse across the synapse. As this was a straight recall from the specification, examiners looked for precise and clear wording. It was important that candidates used terms such as sensory neuron, vesicle, diffusion, receptor and impulse. The main reason for poor scoring was lack of knowledge of the mechanism, but also poor use of these key terms.

(d) This question demanded some high level skills. Candidates had to apply their knowledge in the context of the question. Most able candidates discussed the effect of the lack of receptors as being the limiting factor in the gasping reflex.

(e) Candidates here confused the effects of ecstasy and serotonin. Many talked about ecstasy rather than serotonin stimulating receptors. Again, this was a difficult question – perhaps good advice to give to candidates is to allow time to re-read the pre-release material in the examination. It is not necessary to be writing all the time to get a high score. Most knew the effects that ecstasy has, but some confused the brain and body. Effects on the body, such as dehydration, were not credited; the question emphatically asked about effects on the brain.

A220 – Twenty First Century Additional Science A (Practical Investigation)

General Comments

This is the first year of the A220 Additional Science specification. A substantial number of Centres made late (sometimes very late) entries for the Skills Assessment. One cause appeared to be a lack of familiarity with entry requirements, so that Centres did not realise that they needed to register candidates for coursework moderation as well as for the examination papers and subject aggregation. It is to be hoped that this will not occur again, as it put moderators under great time pressure to complete the work.

Considering the very large number of Centres involved, only a small proportion required mark adjustments to bring them into line with national standards which was very pleasing. However, there were a significant number of Centres that were very close to the tolerance allowed and will need to act on moderators' comments to ensure that there are no problems next year. The agreement between the moderator and Centre in the total marks awarded for each candidate's piece of work was generally quite close although the individual marks awarded for the strands and aspects in the assessment framework varied. Overall, teachers are to be congratulated on the very good transfer of assessment skills from the legacy to the new specifications.

Structure of the report

This report is divided into the following sections

- Administrative aspects
- Supervision and management of coursework
- Marking grids and best fit model of marking
- Marking strands I and P
- Investigations
- Grade Thresholds

Administrative aspects

Due to the large number of centres submitting coursework this year it was perhaps not surprising that there were a significant number of administrative problems. Moderators included in their request for the coursework sample a simple checklist for Centres to use to ensure that everything that was needed was included. This helped both centres and moderators to improve efficiency and effectiveness.

The best Centres followed this checklist and included:

- The MS1 sheet or other OCR approved method, clearly showing the total marks awarded
- A spreadsheet showing the rank order and teaching sets of candidates
- The centre authentication sheet (CCS160)
- Candidates work stapled in the left-hand corner with the appropriate OCR front cover showing the details of the mark breakdown
- Details of how each of the tasks used for assessment had been introduced and presented to candidates and any further supporting material
- Annotation on candidates' work in the sample showing where and why the marks were awarded
- Documentation with contact name, phone number and email address for the person responsible for administration of the sample of coursework
- Details of internal standardisation procedures. Some Centres marked the exemplar material provided at an OCR INSET session and discussed and noted good practice. and then selected work from within the Centre to cross-moderate.

However, a significant minority of centres did not appear to give enough care and attention to administrative aspects to ensure that their candidates received the correct total marks and that moderation proceeded smoothly. This caused numerous problems for the team of moderators given the short timescale for the completion of the moderation process.

The following were the most common problems:

- Errors in transcription to the MS1 form
- The copy of the MS1 sent to the moderator showing the marks of each candidate was often not legible
- Mark changes to candidates' work at the internal moderation stage not being carried forward to the MS1 sheet.
- Misunderstanding of the best-fit approach to awarding marks
- Missing front coversheet on candidates' work
- Poor annotation showing where the marks were awarded. In some cases the annotations did not match the mark on the coversheet. In Investigations, those Centres who used a simple coding, such as I(a) 4, helped considerably to identify where the evidence could be found to help moderators confirm Centres' judgements.
- Minimal description of how tasks were introduced to candidates
- Little information about internal moderation procedures.

Following guidance from the Joint Council for Qualifications (JCQ), coursework can be submitted for as many specifications as it is valid for. This means that it has to match both type (e.g. Data Analysis and Case Study) and context (i.e. Biology, Chemistry or Physics) as appropriate for the specification concerned. A number of Centres did not follow these requirements with respect to context and this will not be acceptable next year. Furthermore, if the same piece of coursework is submitted for more than one specification then it must be photocopied and put into the appropriate sample. Many Centres did not help the moderation process work efficiently in this way.

Moderators also commented that there were a significant number of Centres that did not send the mark lists and samples promptly. On occasions it was difficult for moderators to make rapid contact with the person who was responsible for the administrative paperwork to sort out any problems and this slowed the moderation process. The position of half-term in many Centres in the middle of the moderating period was recognised as a contributing factor to some aspects of this problem.

Supervision/administration of coursework

There was evidence that some coursework from a 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 which are available in all schools. This can be downloaded through the internet, at the following link:

(http://www.jcq.org.uk/attachments/published/315/ICE%20Coursework%202007%20FINAL.pdf)

The following quotes are from this document:

"Candidates should be clear about the criteria they are expected to meet in their coursework… they may need some further explanation or interpretation before they fully understand the nature of the skills they are expected to demonstrate."

"Teachers may review coursework before it is handed in for final assessment. Provided that advice remains at the general level, enabling the candidate to take the initiative in making amendments, there is no need to record this advice as assistance or to deduct marks. Generally one review would be expected to be sufficient to enable candidates to understand the demands of the assessment criteria."

"Having reviewed the candidate's coursework it is not acceptable for teachers to give, either to individual candidates or to groups, detailed advice and suggestions as to how the work may be improved in order to meet the assessment criteria. 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),"

"Once work is submitted for final assessment it may not be revised: in no circumstances are 'fair copies' of marked work allowed".

Marking grids and best fit model of marking

The majority of Centres recorded their marking decisions on the OCR marking grids and used the completed grid as a cover-sheet for the work of each candidate as required. However, some Centres did not appreciate that in the best fit model of marking, **all** aspects of performance of a given strand must be assessed and then a 'best fit' mark selected. The award of marks is based on the professional judgement of the science teacher, working within a framework of descriptions of performance which are divided into **strands and aspects**. 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.

The single, overall, mark for the whole strand is then taken as the best fit to the level of performance shown. In the marking of the Investigation, each strand is divided into three aspects. Therefore the best fit strand mark would normally be the average of the marks judged

for the individual aspects rounding to the nearest whole number. All aspects of that strand must be considered in arriving at the strand mark; if there is no evidence of achievement for an aspect, a mark of zero should be recorded and included in the calculation of the overall strand mark.

For example: E(a)5, E(b)4, E(c)6 Strand E = (5+4+6)/3 = 5 marks
E(a)6, E(b)4, E(c)6 Strand E = (6+4+6)/3 = 5 marks
E(a)7, E(b)4, E(c)6 Strand E = (7+4+6)/3 = 6 marks
E(a)7, E(b)6, E(c)2 Strand E = (7+6+2)/3 = 5 marks
E(a)7, E(b)6, E(c)0 Strand E = (7+6+0)/3 = 4 marks

This approach provides a balanced consideration of each aspect of performance involved in each strand and allows the marker to build up a profile of strengths and weaknesses in the work. Comparison of teacher and moderator judgements in each aspect allows easy identification of where a Centre marks too severely, too leniently or where marking is inconsistent. This allows moderators to make far more constructive reports back to Centres.
There was a tendency for some Centres to award marks on the basis of candidates matching one high level performance description rather than treating the descriptions in a hierarchical way and ensuring that the underpinning descriptions had been matched. A few Centres just counted the highest mark for any aspect to arrive at the strand mark.

Marking strands I and P in Investigations

In a few instances, dotted lines on the assessment scheme are used to indicate alternative ways of obtaining credit and a number of Centres did not seem to appreciate what to do in these circumstances. Aspect (a) of strand I and aspect (b) of strand P are sub-divided in this way. This allows increased flexibility, so that the scheme can be applied to a wider variety of different types of activity. This arrangement evolved gradually during the pilot stage of development of the specification and there are some documents with older versions of the assessment grid still in existence in some Centres. Centres should take care to use the version in the current specification, available on the web site www.ocr.org.uk.

Strand I aspect (a) involves awarding credit for processing the data which has been collected to display any patterns. This may be achieved either graphically or by numerical processing, whichever is most appropriate in a particular Investigation. If there is some evidence for both approaches, then both should be marked and the better of the two counted.

Strand	Aspect of performance	0	1	2	3	4	5	6	7	8	Strand mark
I	Graphical processing of data **or** numerical processing data										
	Summary of evidence										
	Explanations suggested										

Strand P aspect (b)

Strand P in Investigations is made up of three aspects:

P(a) describing the work planned and carried out
P(b) recording of data
P(c) general quality of communication

Aspect (b) is sub-divided into three sections to allow it to cover a wider variety of different types of investigation.

	2	4	6	8
P(b)	Major experimental parameters are not recorded. Some data may be missing.	Most relevant data is recorded, but where repeats have been used, average values rather than raw data may be recorded.	All raw data, including repeat values, are recorded.	All relevant parameters and raw data including repeat values are recorded to an appropriate degree of accuracy.
	Labelling of tables is inadequate. Most units are absent or incorrect.	Labelling is unclear or incomplete. Some units may be absent or incorrect.	All quantities are identified, but some units may be omitted.	A substantial body of information is correctly recorded to an appropriate level of accuracy in well-organised ways.
	Observations are incomplete or sketchily recorded.	Recording of observations is adequate but lacks detail.	Observations are adequate and clearly recorded.	Observations are thorough and recorded in full detail.

The first row of aspect (b) is concerned with recording quantitative data (e.g. times, voltages, volumes etc). The second row deals with the use of conventions and rules for showing units or for labelling in tables etc. The third row of aspect (b) deals with recording of qualitative data (e.g. colours, smells etc). Most investigations are of a quantitative nature and will provide evidence for the first and second rows; they should be considered together and a best fit mark given for aspect (b), ignoring the third row because it is not relevant in this case. For those rare investigations which do not include quantitative but only qualitative evidence, the mark for aspect (b) should be based on the second and third rows only. Once the 'best fit' mark for aspect (b) has been decided, it can be combined with the marks for (a) and (c) to provide the average and so the best fit mark for the strand.

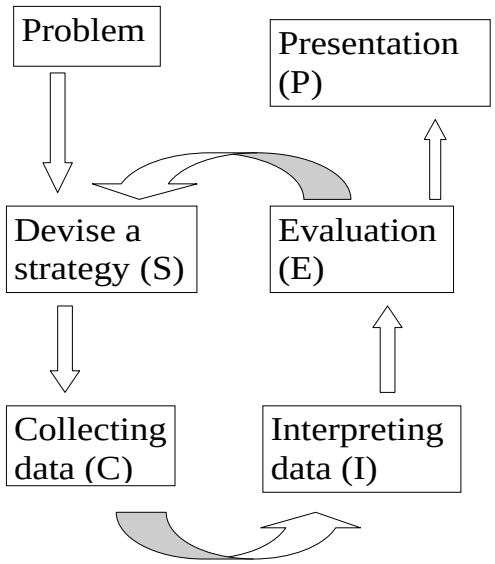
For example, in an investigation providing quantitative evidence:

Aspect of performance			**Strand P mark**
P(a)	7	7	**6**
P(b)	(i) 6	5	
	(ii) 4		
	(iii) not relevant		
P(c)	7	7	

Sub-dividing aspect (b) in this way allows flexibility in marking the recording of data without allowing aspect (b) to dominate the mark for the whole strand.

Investigations

It was particularly noticeable that in this first year of the new specifications that require investigations many Centres continued to follow the previous Sc1 approach towards investigations. Many centres had not taken up the spirit and direction of Twenty First Century Science investigations and this made it difficult for candidates to access the higher marks.



The essential features of a scientific investigation have of course been maintained in this new model. However, the importance of candidates doing preliminary work, developing and exploring methods and techniques, and selecting appropriate apparatus rather than following a given or standard procedure are perhaps the key differences when developing a strategy.
Gathering initial data, making a preliminary analysis and evaluation to modify the initial method to obtain better and more reliable and accurate results, and informing the main method are key aspects which are essential for access to the higher marks.

Key differences between the Sc1 and the Twenty First Century Science model are

- more credit given for candidates who show innovation and imagination
- more credit given for the exploration and development of a strategy in terms of techniques and apparatus rather than following a standard/given technique
- less emphasis on candidates making predictions and knowing the answer before they start.
- more emphasis on rewarding the quality of the data collected
- a best fit approach to marking and assessment using a framework of performance descriptions
- uncoupling of 'sub-skills'
- total marks from one investigation count (no cherry picking of marks for different strands from different investigations or using the I and/or E marks from a data analysis task)

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. Many candidates used scientific knowledge to make predictions about the outcome of the investigation at the beginning of the investigation (Sc1 style) whereas the C21 model aims to give credit for candidates who process their results, look for patterns and then suggest explanations using their scientific knowledge and understanding.

Familiar investigations such as 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 beginning to be used, for example, stretching of plastics and other materials, exercise and fitness routines, efficiency of wind turbines, objects rolling down slopes or ski jumps, and which lemonade is best?

There was very often little information provided by Centres about how the investigation had been presented to candidates and this made it difficult to support the marks for S(c), the autonomy and independence aspect. This was particularly the case when it was clear that most of the candidates in the sample followed a very similar method and procedure.

Strand S: Strategy

Candidates who were awarded up to 6 marks were generally correctly marked. However, those candidates who were given higher marks were often not securely matched to the performance descriptions.

The intention is to encourage a more independent approach to investigation by candidates, and the mark awarded for the aspect, S(c), should reflect the 'value added' by the candidate, beyond the initial teacher stimulus. Most candidates developed their investigation from a more general brief provided by their teachers and this meant that few achieved higher than 6 marks for this aspect. It was noted that, in some cases, high marks were awarded even where candidates had identical ranges and values of the same variables, without any further discussion or justification. This indicated that limited individual decision making had occurred and consequently marks were adjusted downwards by the moderator putting the Centres concerned close to the tolerance limit or even beyond it.

In aspect (a), many candidates developed an investigation in a straightforward way and collected a good range of data, S(a)6, and used, but not necessarily selected, appropriate apparatus, S(b)6, from a general brief provided by their teachers, S(c)6. In aspect (b), whilst most candidates listed the apparatus and described the method they were going to use, only a few candidates described in sufficient depth and detail **why** they had selected the techniques and equipment used. For example, in the thiosulfate/acid investigation most candidates followed the familiar method of the 'disappearing cross' and measured the time when the cross could no longer been seen, obtaining 6 marks for this strand. Those candidates who were correctly awarded higher marks showed a more independent, thorough and rigorous approach. For example, candidates might consider what methods could be used to study the rate of this reaction such as measuring the volume of the sulphur dioxide gas, filtering off the sulphur and weighing it, measuring the pH of the solution or measuring any temperature change (etc). The candidate might consider each possible method and eliminate some and select the most appropriate method.

Candidates might directly suggest the disappearing cross technique from previous experience but they would need to perform preliminary work to find the best apparatus and the best conditions to produce accurate and reliable data e.g.

- a measuring cylinder to measure volumes +/- 1 cm^3
- a stop clock to measure to +/- 1 second
- a conical flask for shaking
- a thermometer to measure any change in temperature in the solutions
- use the same experimenter to ensure consistency of observation
- keep the depth of the solution the same to ensure consistency of observation
- experiment whether the solution should be left standing or shaken periodically
- experiment whether to change the concentration of the acid or the thiosulfate.

Therefore, even in what appears to be a straightforward investigation there are a number of possible routes that a good student could possibly explore. The complexity of a task represents an overall judgement about a number of things such as the familiarity of the activity and method, the ease of observation or measurement, 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. For candidates working at the high mark levels it would be expected that the candidate had some autonomy in deciding what preliminary work to do and in choosing the final technique and ranges used, so evidence related to S(b), S(c), C(b) and C(c) would all help to support the decisions in S(a).

Strand C: Collecting data

Many candidates generally achieved their best marks in this strand. Using suitable ranges of the appropriate variable to investigate and the need to repeat measurements were appreciated by the majority of candidates. However, in many cases the discussion about the identification and control of any interfering factors was surprisingly limited. Many candidates left it to be implicitly deduced from inspection of the table of results rather than any explicit discussion and comment about the need to control variables. Only those candidates who were awarded 7 or 8 marks provided further detail about how the factors had been monitored or controlled. In many cases when investigating rates, candidates stated that since the reaction had been carried out at room temperature the temperature had been controlled. In order to obtain a better match with the 8 mark criteria in aspect (a), candidates need to write much more fully about the context and purpose of their experiments and to discuss any factors which might interfere with the results.

Preliminary work is essential if candidates are to be awarded 7 or 8 marks in aspects (b) and (c). They must perform preliminary work to establish the range of values of the appropriate variable to be used in their investigation. Some candidates did perform preliminary work but did not use the results to explain how it informed their main method. Too often, candidates left consideration of reliability of their results until their evaluation, so that obvious outliers were either ignored, or included without comment in calculating average values. It was very rare to see a test repeated to check and obtain a more reliable result. The better candidates adapted and developed their initial work and modified their techniques accordingly to ensure that they produced data of the best quality.

Strand I: Interpreting data

In general, candidates achieved their poorest marks in this strand and strand E.

I(a): Most candidates analysed their data using bar charts or graphs to illustrate and process the data that they had collected rather than carrying out a numerical analysis. However, some Centres did not appreciate the nature of the 'dotted line' dividing aspect (a) into two approaches, graphical or numerical. As explained in detail earlier in this report, candidates can be assessed on graphical **and/or** numerical processing of data as appropriate and the higher mark can be used in the assessment of this aspect. There is, of course, an inherent understanding that there must be a level of comparability in level of demand between these two routes when awarding similar marks.

It was pleasing to see that the majority of candidates repeated their measurements and included range bars on their graphs indicating the spread and scatter of the results. However, in many cases the graphical work presented by candidates was not of suitable quality for the marks awarded. For example, poor care in general presentation, incorrectly labelled or scaled axes, incorrectly plotted points and poor accuracy of the best fit line. Computer-generated graphs are acceptable but it was noticeable that the best fit line was not always correctly produced and it was generally better for candidates to hand draw their own best fit line.

Some Centres were giving 7 or 8 marks for graphs which were not warranted. Centres must recognise that to be awarded 7 or 8 marks, an indication of the spread of data must be shown **in addition** to the requirements for 6 marks. Candidates generally either plotted the averages with the appropriate range bars or plotted all their raw data with a suitable key.

The following guidelines might help to clarify the assessment of aspect (a) but it is not intended to be comprehensive and to cover all eventualities:

- I(a) 7/8 - accurately plotted graph including a line of best fit and evidence of awareness of uncertainty in data, e.g. range bars, scatter graphs

- I(a) 6 - graph with a best fit line, correctly plotted points, correctly labelled and scaled axes
- 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) 4 - simple charts, bar charts

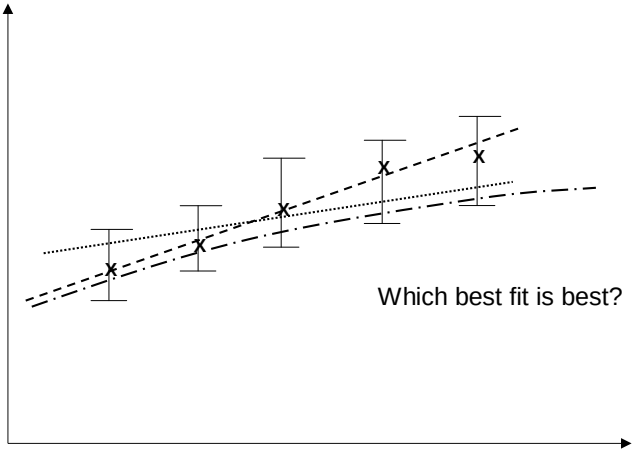
For the numerical approach it is expected that candidates will be able to correctly calculate averages from repeat readings for 4 marks, do more complex calculations such as calculate percentage differences for 6 marks and for 8 marks calculate gradients from graphs or use simple statistical methods such as box and whisker plots. There were cases when candidates used equations to process numerical data such as use of Ohm's Law, or energy change equations. The following guidelines might help when awarding marks but it must be stressed that level of complexity and demand must as always be taken into account.

- I(a) 6/7 – depending on complexity, a candidate substitutes appropriate measurements into an equation, correctly performs the appropriate calculation and excludes outliers when calculating
- I(a) 5/6 - depending on complexity, a candidate substitutes appropriate measurements into an equation, correctly performs the appropriate calculation but includes outliers when calculating averages or includes another minor error
- I(a) 4- a candidate substitutes appropriate measurements into an equation but does not calculate averages or calculates averages only.

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 to match I(b)6 with little evidence to support this award. Many candidates referred to 'positive correlation' when they should have said 'Y is directly proportional to X'.

Candidates should consider the patterns and trends and use their data to derive a more formal or quantitative relationship to ensure a secure match with I(b)6. For example, using and quoting the data to show 'as the concentration is doubled the rate doubles', or calculating slopes/gradients and then stating some formal or quantitative relationship between them and the variable studied. Candidates appeared to find it easier to express relationships when dealing with continuous variables. In those experiments which only involved categoric or discrete variables, candidates generally made simple comparisons of arbitrarily chosen pairs of results without bringing out any overall conclusion.

Aspect (b) at the highest level, builds on and extends that found in the previous Sc1.2 model. It requires candidates to review any limitations to their conclusions by considering such things as the scatter in the data, what might happen outside the range of values studied, any overlapping range bars between data points, 'real differences' and values of the best estimate, and whether the best fit line be precisely 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): In many cases candidates did not link their scientific knowledge and understanding to explain their particular conclusion, but related it to a more general situation. However, most candidates could secure a match to I(c)4 by explaining their conclusion using scientific ideas. Introducing scientific knowledge at this mark level is proving more demanding than the comparable level in the previous Sc1.2 model. However, there was some generous marking when matching to I(c)6 and I(c)8 in terms of the depth and quality of the scientific knowledge and understanding shown. In general terms, 5/6 marks would be expected to be awarded to an explanation at about the grade C standard and 7/8 marks at about the grade A standard.

Strand E: Evaluation

The importance of considering the accuracy and reliability of data and its consequent evaluation is an essential feature of this course. It is therefore of concern that the majority of candidates only achieved between 3 or 5 marks for this strand. Candidates should be encouraged to use the appropriate IaS (Ideas about Science) vocabulary and refer to ideas from IaS 1 when discussing the quality of their data.
In many evaluations, credit was given to candidates for describing what is human error rather than an experimental error.

E(a): Candidates are expected to comment on their procedures and to describe improvements or alternative ways to collect their data. Many candidates discussed improvements to their practical procedures, E(a)6, but failed to discuss the limitations of their procedures E(a)4. There was a tendency for some Centres to award marks on the basis of any hint of matching one performance description, rather than checking each level in a hierarchical way. The E(a)4 aspect of performance is really the 'gatekeeper' to access the higher marks. Many candidates suggested possible improvements although they were not always of sufficient quality to be creditworthy e.g. 'do it with a computer', 'repeat my measurements more times' without any justification or explanation, 'be more careful next time I do the experiment' etc. References to such things as better temperature control using a thermostat controlled water bath in a rates experiment or including a variable resistor in the circuit to keep the current constant in the resistance of a wire experiment were more suitable and creditable suggestions.

E(b): Candidates generally identified a data point as an outlier either in the table of results or on the graph although it was not always clear why a candidate had selected a particular result as an outlier. Few candidates considered the range in their repeat measurements to give an estimate of reliability and the general pattern in their results, closeness of data to the best fit line for example, as a basis for assessing accuracy. 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.

Better candidates made a decision about whether unexplained outliers should be included in the data and in ranges of repeat readings. Some candidates used simple statistics such as variations of the Q test procedure to try and be more objective when rejecting suspect observations and relating to confidence levels.

E(c): Marks were often rather generously awarded and this aspect was poorly addressed by candidates. Candidates often just discussed the reliability of their data without really linking it to their conclusion and saying whether the uncertainty in their data is sufficient to have any significant effect on the conclusion that they have made.

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, e.g. a limited range or not enough readings at certain values, or degree of scatter too

large or variable, together with detailed suggestions about what further data could be collected to make the conclusions more secure.

Some candidates recognised that their conclusion can only apply to the range of values that were studied because outside this range other, specific changes may occur. For example, rates of reaction are bound to slow down as one of the chemicals gets used up, rubber bands eventually break, more exercise cannot always mean that pulse rate continues to increase, etc. Many candidates provided further comment about the confidence level 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, calculated resistivity and then compared this 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 which would have helped many candidates who have language difficulties.
Data was generally accurately recorded and presented in appropriate tabular form, although the difficulty of recording 'time' in consistent and appropriate units was often seen. The allocation of marks for P(b) often proved problematic and more details can be found in the administrative section of this report.

Final comment

All members of the moderating team remarked on the care and effort put in by teachers to provide varied opportunities and motivating contexts for their candidates to achieve the best results in this new assessment framework. We would like to record our thanks and appreciation for a good job, thoroughly well done.
The importance of cluster group meetings, attendance at OCR INSET meetings both in- and out-of house, using the OCR consultancy service for checking marked scripts, and consulting and using the teacher guidance booklets on www.ocr.org.uk are all available methods to improve the awareness and understanding of this new assessment programme. It is highly advisable that staff have time during the year for internal standardisation meetings to share and develop expertise in the Science Department.

2008 Grade thresholds for Investigations

	Grade Thresholds								
Component	**Maximum mark**	**A***	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Investigations	40	33	30	26	23	19	16	13	10

The grade thresholds have been decided on the basis of the coursework that was presented for award in June 2008. It should be noted that this was the first cohort of candidates to submit 'Investigations' for assessment purposes. Thus, the threshold marks will not necessarily be the same in subsequent awards. Some adjustments may be expected as experience with the criteria grows, and a wider range of Centres becomes involved.

Grade Thresholds

General Certificate of Secondary Education
Additional Science A (Specification Code J631)
June 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A*	A	B	C	D	E	F	G	U
A215/01	Raw	42	N/A	N/A	N/A	26	22	18	15	12	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A215/02	Raw	42	30	26	21	17	13	11	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A216/01	Raw	42	N/A	N/A	N/A	28	24	21	18	15	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A216/02	Raw	42	34	29	23	18	14	12	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A217/01	Raw	42	N/A	N/A	N/A	26	22	18	14	10	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A217/02	Raw	42	34	30	25	20	14	11	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A218/01	Raw	40	N/A	N/A	N/A	21	17	13	9	5	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A218/02	Raw	40	23	19	14	10	6	4	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A220	Raw	40	33	30	26	23	19	16	13	10	0
	UMS	100	90	80	70	60	50	40	30	20	0

A220 (Coursework) - The grade thresholds have been determined on the basis of the work that was presented for award in June 2008. The threshold marks will not necessarily be the same in subsequent awards.

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	A*	A	B	C	D	E	F	G	U
J631	300	270	240	210	180	150	120	90	60	0

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

	A*	A	B	C	D	E	F	G	U	Total No. of Cands
J631	5.6	20.3	47.7	76.6	91.0	97.1	99.3	99.9	100	66 384

71 375 candidates were entered for aggregation this series

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

Statistics are correct at the time of publication.

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