OCR
RECOGNISING ACHIEVEMENT

GCSE

Biology A
Twenty First Century Science

General Certificate of Secondary Education **J633**

Report on the Units

June 2008

J633/MS/R/08

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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GCSE Twenty First Century Science - Biology A (J633)

REPORTS ON THE UNITS

A221/01 – Twenty First Century Science Biology A (B1, B2, B3) Foundation Tier

General Comments

The paper was completed by all candidates in the allocated time. Most candidates performed well and were able to demonstrate what they knew and understood. There was a good range of marks on the paper and candidate scores ranged from very low to almost full marks in a minority of cases. Candidates would be well advised to look at available marks and ensure that they have given the correct number of responses for multiple response questions.

Comments on Individual Questions

Q1a) Most candidates scored at least 1 of the 2 marks available for this question with over half of them achieving full marks i.e. “short of breath” and “many chest infections”

Q1b) Candidates tended to score either 2 marks or 0 marks on this question since both sections required the same understanding of genotype formation.

Q1c) Candidates found this question quite challenging and were not sure as to where to place the “d” on the second chromosome.

Q2a) Half the candidates were able to answer this question and scored 1 mark. The most common mistake was the box ticked “The modified cells are made from the missing protein”.

Q2b(i) Just over 30% of candidates wrote “Jim” as the doctor describing a treatment which was not a cure, obtaining 1 mark.

Q2b(ii) Most candidates scored at least 1 mark on this section ; “Robert” being the most popular choice.

Q2b(iii) This question was well answered with most candidates achieving at least 1 mark and the majority 2marks.

Q2(c) Most candidates gained 1 mark on this question for the response “they are unspecialised”

Q3a(i) Most candidates scored at least 1 mark on this question with the majority scoring 3.

Q3a(ii) Many candidates ticked the correct box showing that they knew that “a vaccine contains a safe form of the virus”

Q3b Most candidates scored the 1 mark available here.

Q3c(i) Most candidates were not able to calculate the number of people likely to suffer a serious side effect.

Q3c(ii) This question was only attempted by more able candidates and very few calculated the % value correctly or even attempted to show working.

Q4a(i) The more able candidates were able to match up the cross section diagrams to the name and then to the function correctly. Many candidates scored 2 marks usually for joining up the name of the blood vessel to the correct function. Some candidates had not appreciated that there was no need to join all the names of the blood vessels to a given function

Q4b Generally well done with most candidates scoring at least 1 or 2 marks.

Q4c Most candidates scored 1 mark

Q4d Most candidates scored 1 mark

Q5a Just over half of the candidates scored 1 mark. Other responses were split between the other boxes.

Q5b In general the majority of candidates scored 1 or 2 marks these being for the answers “copy” and “data”

Q6 Most candidates scored at least 1 mark the most common right answer being no6 relating to the statement “Humans may have directly caused the extinction of the Dodo”

Q7 Most candidates scored at least 1 mark here for either “evolution “ or “confident”

A221/02 – Twenty First Century Science Biology A (B1, B2, B3) Higher Tier

General Comments

Candidates are now clearly well prepared for this objective style of paper, there were very few examples of candidates misreading the rubric and only where answers required recall with no prompts was there a noticeable number of “no responses”. Broadly candidates showed good knowledge across all aspects of the specification tested, exceptions are listed in the comments on individual questions, as well as understanding of Ideas about Science. There was no evidence that candidates ran short of time.

Comments on Individual Questions

1a) This was well answered. Nearly all candidates knew the difference between dominant and recessive alleles but weaker candidates were less sure of the definitions for chromosome and gene.

b) Candidates scored well on this question. The most common error was failing to indicate Philip’s genotype. This is an aspect of genetics that is clearly well understood by higher candidates.

2(a) It was pleasing to see that most candidates could correctly identify the function of genes.

b)(i) Only better candidates understood the difference between treatment and cure and so correctly identified Jim as the doctor.

(ii) Candidates were better at identifying ethical arguments nearly all choosing Marion but Julian proved to be a powerful distractor.

3(a) Most candidates knew that in therapeutic stem cell research the nucleus was replaced but fewer recalled that stem cells are unspecialised, some referred to them as asexual or mitotic, and fewer still that groups of identical cells are a clone giving a wide variety of wrong answers.

b)(i) Most candidates selected F “Taking human life is wrong” and many linked this to C and the idea embryos can develop into human beings but D, that many embryos die of natural causes, was a common mistake.

(ii) This was a difficult question. Candidates often chose B, “that early embryos have no nervous system” and so lost a mark.

4(a) Peer review was well understood and most candidates answered correctly.

(b)(i) & (ii) proved difficult for all but the strongest candidates. More recognised that only 14 people a year in the UK were likely to suffer from serious side effects due to flu vaccinations but many found the calculation of the percentage of the UK population that die each year from flu beyond them.

c) Was well answered, students showing they understood the balance of risks.

d) This was well answered; candidates clearly followed the arguments and understood the effects of vaccination and mutation of the flu virus in the success of vaccination.

e) A surprising number of students thought HIV infects the nervous system.

5)(a, b and c) These questions were well answered by the vast majority of candidates.

(d)(i) A disappointing number of candidates knew that arteries carry blood to heart muscles, most opted for veins.

(ii) More candidates knew that arteries/blood vessels carrying blood away from the heart have to resist high blood pressure with a significant number of wrong answers being that “the blood is moving quickly” which shows some level of understanding.

6)(a) This question was well answered by most candidates with relatively few thinking the evidence sufficient to prove or disprove either theory.

(b) Few candidates, strong or weak, recalled how long ago scientists believe life began on Earth, more recalled that molecules could copy themselves.

(c)(i) Hormonal system was better recalled than nervous, common errors here were: “nerve; brain; CNS, eyes; ears”.

(ii) This was well answered by all but the very weakest candidates.

7(a)(i&ii) Weaker candidates listed most sentence numbers suggesting that this was an area they understood poorly. Many candidates correctly identified hunting as direct human activities and the best candidates also knew what was meant by indirect human activity.

(b) Biodiversity was a common response but weaker candidates often referred to natural or human diversity.

8(a) Theory rather than prediction and certain rather than confident were powerful distracters. Similar questions have been asked before and candidates should be prepared for them in the future.

(b) Most candidates knew that sexual reproduction produced variation but fewer that only mutations in sex cells will be inherited and therefore affect evolutionary change.

A222/01 – Twenty First Century Science Biology A (B4, B5, B6) Foundation Tier

General Comments

Most candidates performed well. There was no evidence that any of the candidates ran out of time. The great majority scored more than 20 marks. It was pleasing to note that almost all candidates answered the questions in the intended ways and in the spaces provided. This suggests that they had generally been well prepared for the examination.

Comments on Individual Questions

Q 1 This question was easily answered by most. In part (a) the majority of candidates selected the two correct responses, and there was a fairly even distribution among the wrong answers. Part (b) was also well answered, with very few candidates scoring no marks. The most common incorrect response was to suggest that sugar was filtered out only.
In part (c) most gave the correct answer; some suggested that alcohol causes a decrease in urine volume. Very few thought it stayed the same.

Q 2 Few failed to score any on this question. In part (a), although the correct answer (homeostasis) was the most popular, hypertension was also thought to be the term for maintaining a correct body temperature.
Part (b) was less well answered, with a minority of candidates linking the correct boxes. The structure of the question meant that it was unlikely that they would score 1 mark, which would require drawing 2 lines to one box or only 2 lines in total.

Q 3 (a) Few candidates gained full marks by drawing lines to connect the correct boxes on both sides. The left hand side, linking the correct diagram with the description, was more successfully answered than the right, where the solution causing the effect was required. The way the question was structured, it was unlikely that they would score 1 or 3 marks.
In part (b) a minority correctly identified the correct description of osmosis.
Part (c) was also not particularly well answered – many thought that adding salt would make the cells larger.

Q 4 (a) Few candidates scored full marks – many were tripped up by trying to use 3 different terms and gave fertilization, meiosis and mitosis rather than mitosis twice.
Part (b) was correctly answered by around half of the candidates. In part (c), around half gave the correct order, scoring 2 marks and many gained just one for a partially correct sequence.

Q 5 (a)(i) This proved to be a straightforward question, with most candidates selecting light as the correct response. In parts (a) (ii) around 60% selected the correct response, and this was broadly true of 5(b)(i) and (b)(ii). In 5(c) more than 60% gave the correct answer.

Q 6(a) The majority gained 2 marks by selecting A and B. In part (b) most gained 1 of the 2 available marks.

Q 7 In part (a)(i), slightly less than half gave the correct response, whereas the majority could identify the fatty sheath for part (a)(ii). Most selected at least one correct function for the sheath in part (a)(iii). Surprisingly, the correct function of receptors was selected by less than 30% of candidates for part 7(b).

Only about 40% of candidates gave intelligence and language as functions of the cerebral cortex to score both marks in Q8(a) but in part (b) they were more successful with around 85% giving the correct response.

Q 9(a) and (b) proved straightforward, with the great majority scoring 2 marks in each part. Even part (c) was accessible to many, who correctly selected the term “peripheral” as a description of the nervous system in the arms and legs.

A222/02 – Twenty First Century Science Biology A (B4, B5, B6) 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 8 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 10 % of candidates getting less than 21 marks out of the 42 available on this paper and nearly half scoring more than 29.

Comments on Individual Questions

Question 1

(a) This part of question 1 was in common with the foundation tier. Almost all candidates successfully identified 'homeostasis' as the process involved in maintaining a constant body temperature.

(b) This part of question 1 was also in common with the foundation tier. Many candidates obtained full marks and found this item accessible. They were able to identify the 'biological' processes involved within an incubator.

(c) Almost all candidates correctly made the association between high temperatures and their impact on enzyme activity.

(d) Very few candidates failed to identify sweating and excretion of urine as the two major routes for water loss. The involvement of digestion in water loss was avoided, since this is not a route for the removal of 'large amounts' of water.

Question 2

(a) Candidates showed a good understanding of osmosis, as demonstrated by red blood cells under different conditions. Although some candidates made an error, most were able to identify the haemolysis of the red blood cells when placed in pure water.

(b) Many candidates correctly identified the definition for osmosis. For those who were uncertain, most avoided the first option because it carried two incorrect references to 'concentrated solution' and 'completely permeable'. Most candidates appeared to be aware of the 'partially permeable' feature of the membrane.

(c) Very few candidates considered choosing the distractors within this item. They were aware that the plant cell wall does provide a resistance to the full disruption or 'bursting' of the cell under conditions of pure water.

(d) This item was more challenging for many candidates. They failed to appreciate the impact of adding 'a large volume' of water to the crenated red blood cells. There was a tendency, for some candidates, to consider that the cells would return to their original size or, for some, to get smaller.

Question 3

(a) The letter 'F', which represented one of the options in the diagram, was missing from the selection of letter options in the examination paper. This appeared to have very little impact on the performance of candidates since many correctly identified the two options, 'B' and 'D', based on their complementary shapes in respect of the enzyme's active site. A handful of candidates added letter 'F' to the list and then ringed this letter. This did not disadvantage them because they were clearly providing this as their choice of response, which was incorrect.

(b) (i) This factual-recall item did not present any significant problems for candidates, most realising that the active site is the location for substrate-binding on the enzyme.

(ii) Again, candidates found this item to be readily-accessible. Few were distracted by the other two options provided.

(iii) Although not all candidates completed this item correctly, many appreciated that the temperature of the solution would affect the 'collision rate' between the enzyme and substrate molecules.

Question 4

(a) All parts of question 4 were in common with the foundation tier. Many candidates made an error when answering this item. Most appeared to understand the process of fertilisation within the model provided since the sex cells were clearly fusing at this point. However, candidates struggled with the choice of nuclear division following this initial stage. Although the item stated that words 'may be used once, more than once or not at all', there was a tendency for candidates to feel that both mitosis and meiosis must appear somewhere. This led such candidates to, incorrectly, choose meiosis for stage B or C in the model.

(b) Although the majority of candidates appreciated that the chromosome number in the sex cells was half that found in the parent cells (as a result of meiosis, but not shown in the model), some were equally puzzled and chose one of the other two responses. No clear pattern emerged.

(c) Candidates tend to find sequence items to be fairly accessible, particularly if the first or last response is shown already. The provision of the first stage, in this case, enabled the candidates to determine the position in the cell cycle. For many, the following stages were identified without too many difficulties. No other clear pattern emerged with regards to those who answered out of sequence.

Question 5

(a) Many candidates did not necessarily know how to respond to the guidance provided in the stem. They had the choice of providing ticks in the correct 'box or boxes'. In this case, the one mark allocated related to two correct boxes ticked i.e. both the number of cells and the width of stem. This led some of the more able candidates to make an error within the item. They did not appreciate that meristems also increased the width of a stem. For some

candidates, an overall confusion seemed to exist and they responded to unrelated options e.g. 'uptake of water'.

(b) The activation of genes during differentiation of cells was fully appreciated by some candidates and they provided the two correct responses. Although no other clear pattern emerged with regards to other responses, there seemed to be some confusion with reference to genes being 'added' or 'lost' from cells.

(c) Very few candidates chose the incorrect response of 'auxin is evenly distributed'. This was avoided by most because they realised that something must be happening in the stem with regards to cell division and growth. However, some candidates were unable to appreciate that the auxin must be at higher levels on the shaded side so that this side grew more, hence the bending towards the light.

(d) Any confusion presented in item (c) could have been reinforced when responding to this following item. However, there did not seem to be a really clear pattern between the two items. The candidates could have (incorrectly) concluded that if auxin reduced the rate of cell growth, then it would collect on the illuminated side of the stem.

Question 6

(a) The majority of candidates found the sequence of amino acids straight forward. They were not distracted by the combinations of bases and were able to make the correct conclusion. If candidates failed to obtain the 2 marks, there was a tendency for them to chosen amino acid 4, instead of amino acid 2 in the last position. They may have felt unsure about missing out an amino acid and repeating another.

(b) It was reassuring to see that many candidates realised that the first amino acid in the sequence was the only one to be unaffected. All other amino acids in the sequence would be different because the base sequence had been changed radically.

Question 7

(a) (i) All parts of question 7 were in common with the foundation tier. Many candidates provided the two correct responses i.e. involuntary and rapid. However, some candidates were somewhat confused and chose others options available. No clear pattern emerged. Very few candidates failed to follow the guidance in this item i.e. they mostly gave two responses, rather than just one for the one mark.

(a) (ii) The identification of the fatty sheath was straightforward for most candidates. The diagram clearly showed a 'sheath-like' structure along the axon.

(a) (iii) Again, most candidates coped well with this item and realised that the sheath both insulates the neuron and increases the speed of nerve impulse transmission. No pattern of alternative responses was apparent.

(b) This factual-recall item did not present a problem for most candidates. They realised that receptors detect stimuli.

Question 8

(a) This item did not present a straight-forward sequence format. The order of events at the synapse had to be understood but the marks related directly to the correct identification of both structures and their function. For example, the candidates had to appreciate that the vesicle was fusing with a membrane at one stage, or releasing a chemical at another stage. Many coped well with this item and obtained all three marks, but a number did not fully appreciate the events at the synapse.

(b) Some candidates were challenged by the effect of the synapse on the speed of nerve impulse transmission. Most, correctly, realised that the processes involved must slow down the rate. However, other candidates either guessed or were genuinely puzzled by this.

(c) Many candidates failed to obtain the two marks for this item. They frequently crossed the linking lines because they assumed that neuron 1 would continue to transmit impulses and that neuron 2 would no longer be able to do this. This is the opposite of the situation at the synapse. However, a few candidates fully appreciated the phenomenon and gave the two correct responses. This item was challenging for many.

(d) Many candidates had a good understanding about the link between serotonin levels and the activity of the drug, ecstasy. Some candidates were either uncertain or guessed when responding to this final item on the paper.

A223/01 – Twenty First Century Science Biology A (Ideas in Context plus B7) Foundation Tier

General Comments

- This is the first time this Unit has been examined.
- It attracted a small entry of 768 candidates from 89 centres.
- The marks awarded ranged from 2 to 47 out of a possible 55 showing a good spread of marks.
- There was no evidence of a lack of time.
- Question 3 was an overlap question and it proved to be very demanding for many candidates.
- There was some evidence of lack of knowledge (pathogens, parasites and prey, joint structure, genetic modification, parasites).
- There was some evidence of lack of understanding of presented data, with some confused answers in Question 5.
- Teachers may be able to improve their candidates' performance by,
    - allocating more time for wide ranging discussions on the pre-release material and posing obvious questions
    - looking at the balance of time spent on remembering/understanding information as well as analysing and discussing it
    - encouraging candidates to carefully read information and not immediately write down the first answer they think of
    - getting candidates to realise when answers need a detailed explanation by the number of allocated marks
    - getting candidates to realise that they must attempt a question carrying a QWC mark.

Comments on Individual Questions

This first question was based on a pre-release article about deadly pathogens.

1 ai It was surprising to note that only 10% of candidates knew what was meant by the word "pathogen". Most candidates thought it was a disease. Since the whole article was about pathogens some candidates struggled to understand the rest of the questions. The response was especially disappointing since the article was released for discussion well before the examination.

aii Slightly more candidates were able to describe what was meant by the word "host".

b Some candidates wrote good answers to explain why scientists used to think that pathogens evolved to become less deadly and showed good logical reasoning. Many candidates wrote a very brief answer despite two marks being available.

ci Nearly all candidates correctly identified the longest surviving pathogen.

cii Since the data could be interpreted in different ways, a wide variety of answers was accepted.

ciii It was surprising to note that less than 50% of candidates were able to pick out the correct information about a new explanation in the article.

d. It was disappointing to note that more than 50% of candidates did not score any marks for this well documented explanation of how scientists get their theories accepted. Many vague and confusing answers were received.

e. The majority of candidates were able to explain side effects.
Parts d and e were overlap questions and were targeted at Grades D and C.

2 This question was based on photosynthesis.

ai. Candidates were expected to complete the word equation for photosynthesis. It was disappointing to note that about one third of the candidates failed to score any marks. A common error was to include sunlight in the equation.

aii. The majority of candidates realised that the source of energy was light.

b. This question about the use of glucose by plants exposed a lack of knowledge and understanding. A score of 3 marks was rare, with about 50% of candidates failing to score any marks.

ci. The majority of candidates found it difficult to explain the phrase "limits the rate of photosynthesis". Many rambling and vague answers were received.

cii. Candidates fared better when explaining how to prevent dim light limiting photosynthesis.

ciii. This question required candidates to identify conditions which would increase the rate of photosynthesis. It achieved good differentiation. A common incorrect choice was "give the plants more glucose".

3 This question was based on genetic modification. It was an overlap question and was targeted at Grades D and C. It proved to be rather demanding.

a. Candidates were required to label the diagram of a bacterium. The majority of candidates thought it was a plant cell and labelled it incorrectly. Few candidates realised that bacteria do not have a nucleus so the last label should have been chromosome/ DNA.

b. Candidates were required to explain how bacteria could be genetically modified and to use the three supplied words. The large number of candidates who did not attempt this question exposed a lack of knowledge. Since this question also carried an extra mark for writing a clear ordered answer, these candidates forfeited four marks.

c. Candidates were expected to select the correct statements about economic, social and ethical implications. It achieved good differentiation.

d. Candidates were asked to name three products from genetically modified bacteria. Despite a wide range of answers being accepted, the majority of candidates failed to score.

4 This question was based on the skeleton.

a. Candidates had to select words from a list to complete sentences about the skeleton. Almost all candidates scored some marks. There was some confusion over ligaments and tendons.

bi. It was rather surprising to see about 45% candidates failing to identify cartilage and synovial fluid in a joint.

bii. Structure 2 was marked independently from what was written down in the previous answer. Again it was surprising to note that only about 40% of candidates could describe the function of structure 2 (synovial fluid).
In previous Biology examinations candidates have usually scored well on questions about the skeleton and joints.

c. The majority of candidates wrote good answers to explain symptoms and treatment for a sprain.

5 This question was based on an article about animal relationships such as parasitism. The candidates' answers showed much confusion. Many candidates either had not read the article or showed a lack of understanding of its contents.

a. Candidates were asked to name a host and a parasite from the article. Some candidates incorrectly named the sea anemone and the clown fish or other animals not named in the article.

b. In i) candidates had to name one other parasite. Again there was much confusion, with candidates naming animals from the article. Having failed to name a correct parasite, candidates had problems in ii) with describing how the parasite was adapted. About 80% of candidates failed to score any marks in ii).

c. The majority of candidates correctly identified the correct statements about the evolution of parasites.

d. The majority of candidates correctly identified the correct effects on humans.

A223/02 – Twenty First Century Science Biology A (Ideas in Context plus B7) Higher Tier

General Comments

This was the first time that this paper had been sat by candidates and it was pleasing to see how well the vast majority of candidates had been prepared for the examination. Most centres had clearly used the pre release material to their full advantage and had prepared their students well to answer the questions.

Comments on Individual Questions

Question 1 was concerned with the pre release material.

1 a Most candidates scored one or two marks on this section, but only the most able went on to score full marks. Credit was given for the idea that the parasite benefited or caused harm, and that it used the host to reproduce and spread to other organisms.

1 b Many candidates scored both marks for this question. Good answers included the idea that the virus mutated or the antigens changed thus making the old vaccine or antibodies ineffective.

1 c This was very well answered. Most candidates correctly stated both parts of the correlation. Credit was also given to those candidates who just stated that it was a positive correlation.

1 d i This was also very well answered. Various examples of diseases were allowed provided the candidate correctly stated that it has a long survival time outside the body and kills more people.

1 d ii This proved to be more taxing for the less able candidates who only scored one of the two marks. Good answers referred to having evidence or data that was published so that other scientists could replicate it.

1 e This was well answered by most candidates who correctly indicated that the vaccine was the cause of the side effects and stated that it was unwanted and gave an example.

Question 2 was about sickle cell anaemia.

2 a Most candidates scored at least one mark on this question for giving an example of at least one symptom. However a significant number of candidates did not understand what was meant by a symptom and failed to score any marks at all.

2 b This proved to be a very hard question. Only a few candidates scored one of the marks for referring to a faulty or mutated allele and even less went on to say that this coded for haemoglobin.

2 c Most scored at least one mark on this question for stating that there was only one faulty allele and many went on to score the second mark by stating that this would cause few or no symptoms.

2 d This question was answered well and proved to be an easy end to the question.

2 e This question discriminated well across the ability range. Very weak candidates scored no marks and the most able gained credit for stating that carriers are more likely to survive than non carriers and will therefore pass on the alleles to the next generation. In order not to penalise candidates who failed to score for 2d, wherever possible the error was carried forward and credit was given.

Question 3 was about genetic modification.

3 a Most candidates scored at least two marks on this question. The most common error was to label the DNA as the nucleus and a few candidates were confused as to which was the cell membrane, and which was the cell wall or capsule.

3 b Credit in this question was also given for a clear and ordered answer. Most candidates managed to score this mark.
More able candidates scored full marks for this question and it was pleasing to see the high quality of some of the responses. Good answers went beyond what was required and correctly referred to restriction enzymes and ligase.

3 c Candidates who read the question mostly scored full marks on this section. Some candidates however decided to produce their own statements, which if correct were credited. However this risky strategy often resulted in no marks being awarded.

3 d A wide range of responses were accepted for this question but it was surprising to see how hard most candidates found it to think of three different products and only the most able scored all three marks.

Question 4 was about respiration

4 a Most candidates failed to score this mark. Good answers referred to ATP but all too often, the answer given was glucose which was not credited. Candidates should have been clued in as the question was asking about what happened after respiration had taken place.

4 b Many candidates scored both marks on this question for correctly stating that glucose and oxygen supplied the muscles with energy.

4 c Although this question was in two parts, it was marked as a one part question with candidates being able to score all four marks in either or both sections. Many candidates scored three marks but very few went on to score all four. Credit was given for not enough oxygen was available and that lactic acid was produced that was then broken down as more oxygen became available. However very few candidates stated that increased breathing rate would also get rid of carbon dioxide.

4 d This was answered well with most candidates scoring at least one mark.

Question 5 was about blood.

5 a This proved to be a straightforward question with many candidates scoring all three marks. Both component and functions had to be correct to score with most quoting the examples of red blood cells, white blood cells, and platelets. However other correct responses were credited.

5 b This proved to be a more difficult question with only the most able candidates referring to antigens or surface proteins (1 mark) on the surface of red blood cells (2nd mark).

5 c i This was answered well by the vast majority of candidates.

5 c ii This was answered well by the vast majority of candidates.

5 d i On previous papers this type of question has proved to be quite difficult for weaker candidates. However, almost all candidates performed very well on this question.

5 d ii Most candidates scored one of the two marks and the more able realised that AB was also a possibility.

A229 – Twenty First Century Biology A (Practical Data Analysis and Case Study)
A230 – Twenty First Century Biology A (Practical Investigation)

General Comments

This is the second year of the Practical Data Analysis and Case Study coursework. However, for many Centres this was the first year of presenting candidates' work for moderation. The scale of the assessment and moderation operation increased significantly this year. Last year some 200 Centres were involved in Practical Data Analysis and Case Studies. This year, 1000 Centres submitted work for more than 225,000 candidate entries across all the specifications within the Twenty First Century Science suite, representing a huge increase in the moderation required.

The moderation team had to be increased substantially and included a good mixture of experienced moderators from the legacy and Pilot specifications and new moderators with experience of teaching Twenty First Century Science.

In Biology A, there was approximately an equal number of candidate entries for the two different Skills Assessment routes, whereas in Chemistry A and Physics A there was approximately twice as many candidates opting for the Investigation route as compared to the Data Analysis and Case Study.

A substantial number of Centres made late (sometimes very late) entries for the Skills Assessment. One cause appeared to be lack of familiarity with UMS systems, so that Centres did not realise 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.

It appears from discussions with people attending INSET that the Principal Moderator Report for 2007 had not always been seen and read. Therefore some of the comments and guidance has been repeated again in this report.

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 B and C in case studies
- Marking strands I and P in data analyses and practical investigations
- Data Analysis
- Case Studies
- 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 the Practical Data Analysis, 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 and management 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 coversheet 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 Data Analysis, 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 B and C in case studies

In the marking of the Case Study, strands A and D also have three aspects and a similar best fit procedure to that described above can be used.
However, in strands B and C there are only two aspects in each, and in some cases a professional judgement has to be made when arriving at the best fit strand mark from the average, for example, if 4 marks are awarded for B(a) and 3 marks for B(b). From experience in these cases it is often best to consider both strands B and C together, when arriving at the final strand mark for each. For example, if B(a)4, B(b)3 and C(a) 4, C(b)3 are awarded, then it would be appropriate to award B = 4 by rounding up and C= 3 by rounding down (or vice versa) for a total of 7 marks for these two strands taken together.

Marking strands I and P in data analyses and practical 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 Data Analysis. 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 Data Analysis 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 Data Analysis assessments 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 Data Analysis assessments 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 a Data Analysis providing quantitative evidence:

<table>
<tr><th>Aspect of performance</th><th></th><th></th><th>Strand P mark</th></tr>
<tr><td>P(a)</td><td>7</td><td>7</td><td rowspan="5">6</td></tr>
<tr><td rowspan="3">P(b)</td><td>(i) 6</td><td>5</td></tr>
<tr><td>(ii) 4</td><td></td></tr>
<tr><td>(iii) not relevant</td><td></td></tr>
<tr><td>P(c)</td><td>7</td><td>7</td></tr>
</table>

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.

Data Analysis

General comments

The Data Analysis task provides the opportunity to assess candidates understanding of 'Ideas about Science', particularly IaS 1, 2, and 3. Those candidates who used the language and concepts related to IaS, such as 'correlation and cause', 'outliers', 'reliability', 'accuracy', 'best estimate', and 'real difference' found it much easier to match the performance descriptions of the criteria and gain higher marks.

The majority of Centres clearly understood the information included in the specification about the nature of the Data Analysis task that can be used for assessment purposes. **Candidates must have personal firsthand experience of collecting data by performing a practical experiment.** Candidates then analyse and evaluate this data and are assessed against the criteria in the specification. The data that they collect can be supplemented by further data from, for example, incorporating a class set of results. Work which is based purely on teacher demonstrations, computer simulations, given sets of results etc, is not acceptable. Centres which do not fulfil this requirement will put the marks of their candidates in jeopardy. Therefore, it is very important that Centres include details of how the task was presented to their candidates. It is also important that candidates record and present the data that they have collected and not just plot a graph or do numerical calculations without any reference to the original data.

The better Centres introduced their candidates to the data task and involved them in discussion of the procedures and apparatus rather than just presenting candidates with a detailed worksheet. The whole class situation allows interactive discussion of the experiment so that all candidates understand the reasons why particular methods or ranges of values were chosen. It also allows all candidates to have access to a substantial body of data to provide a firm basis for interpretation and evaluation.

The same Strand I and E assessment criteria are used in investigations in Additional Science and the same marks for I and E from investigations can be submitted for Data Analysis as well.

A few Centres did not appear to appreciate this possibility and in a number of cases, on the advice of the moderator, the marks of their candidates had to be adjusted to produce a more favourable outcome.

Many candidates appeared to be better placed to make realistic evaluations of their procedures and data collected through an investigation, rather than through a standalone data analysis experiment. However, in the case of weaker candidates, the data collected was often poor in quality and quantity so that they found interpretation difficult. Therefore, in these cases data analysis activities involving whole class participation were generally the most successful.

In strand I, compared to the previous Sc1.2 criteria, there is an increased demand in the assessment of graphical/numerical skills and of the ability to summarise evidence. A similar, but less marked, effect occurs in strand E. This increased demand resulted in a greater spread of marks, reflecting the different abilities of candidates, and gave clearer differentiation and consequently more secure grading.

Data Analysis Tasks

There was a great variety of data tasks seen by moderators, which was very encouraging, such as:

pulse rates and exercise;
osmosis;
enzyme studies;
rates of reaction;

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

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 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

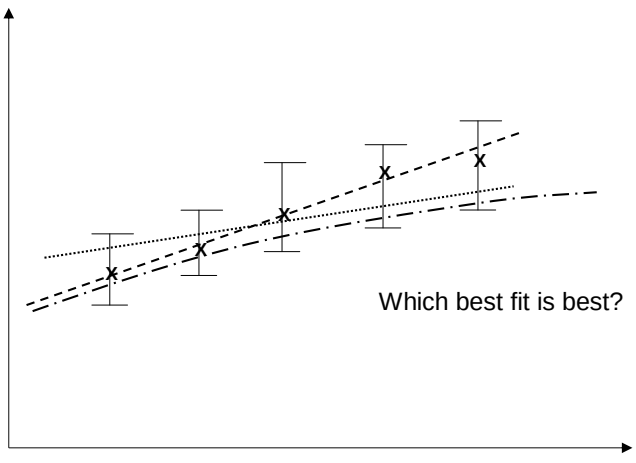
For the numerical approach it is expected that candidates will be able to correctly calculate averages from repeat readings for 4 marks, do more complex calculations such as calculate percentage differences for 6 marks and for 8 marks calculate gradients from graphs or use simple statistical methods 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.

Case Studies

General comments

Case Studies continue to be a very successful aspect of the course and have drawn a most positive and enthusiastic response from candidates of all abilities. A number of comments made in last year's report are still appropriate and relevant this year. Case Studies are used to assess candidates' understanding of all aspects of 'Ideas about Science' (IaS), but particularly IaS 4, 5 and 6. The purpose of the Case Study is to encourage candidates to use their knowledge and understanding of the IaS to make judgements when presented with controversial issues which have claims and opinions for both sides of the case. There is still a great deal of evidence that many candidates are not being taught to use these skills when approaching their Case Studies. Where candidates 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', and 'technical feasibility and values' they found it much easier to match the performance descriptions of the criteria and gain higher marks.

Case Studies are always best formulated in terms of a question to provide a focus in an area of controversy. For example, 'does air pollution cause asthma?' rather than just 'asthma'. A question will encourage candidates to look for different opinions and views, and to consider the evidence base for claims and the reliability of sources. Studies which were presented as questions to answer were always more effective than those which simply **described** a topic. The Case Study is not a report on a topic but a critical analysis of a controversial issue. Some topics are so uncontroversial that there are no valid opposing views.

In some Centres, all candidates were given the same topic title whereas in others a broader range of opportunities was given. In general, the latter approach was more successful. However, it is wise for teachers to closely monitor their candidates' choice and perhaps limit this to topics which have been covered in course modules. This means that candidates will have access to some basic explanatory science from their student book which will provide them with a good starting position for their study, and at least one book reference for their bibliography. However, whatever arrangements were adopted it was clear that students showed a sense of 'ownership' of the study, and even very weak students managed to produce sensible reports. The key point is that the Case Study question must invite debate and discussion of both sides of the case and be firmly embedded in a scientific context so that candidates can use their scientific knowledge and understanding and their understanding of IaS to produce a balanced account.

Choice of subjects for Case Studies

It was interesting to note that there appeared to be a slight shift in the popularity of subjects for Case Studies compared to last year, e.g. less on smoking and sunbathing issues but more on cloning and energy sources for the future. Case Studies will, and should, slightly shift and evolve as different issues arise in the news and also as new information and evidence is presented to change opinions and views. This will help to maintain motivation and enthusiasm.

Case Study titles included:

Aspects of diet, e.g. Is obesity inherited?
Food additives – are they good or bad?
Should GM crops be allowed?
Should human cloning be allowed?
Are mobile phones bad for your health?
Is the MMR jab safe?
Does motor traffic cause asthma?
Should animal testing be allowed?

Some centres picked on issues closer to home, e.g. 'dolphins caught in local fishing nets' as a stimulus for 'extinction' issues. There were some Case Studies which were founded on considerable ethical or moral viewpoints and limited science, and this made it difficult for candidates to access high marks in parts of Strands B and C.

Assessment

In general, candidates performed better in Strands A and D compared to B and C. The majority of candidates presented their work using good IT skills but the substance and quality of the work did not always match the high standard of presentation. However, many candidates did produce work which was quite outstanding and was a pleasure to read and moderate. The more successful 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 achieving 20 or more marks. Reports from the weakest candidates often consisted of perhaps two or three 'cut-and-paste' sections from a limited number of sources with minimal editorial comment from the candidate. Thus candidates in this group had selected relevant material from a source, made some attempt to link the facts together and present a report achieving perhaps 5 or 6 marks. Even middle-achieving candidates cut-and-pasted information from the internet and did not always comment on the information and interpret and analyse it sufficiently. The amount of added value in terms of analysis and evaluation by the candidate was often variable in these cases. This limited significantly the marks awarded in Strands B and C and also in D(c) where marks awarded for spelling, punctuation and grammar and the use of scientific vocabulary has to be decided on the words used by the candidate and not on the downloaded information.

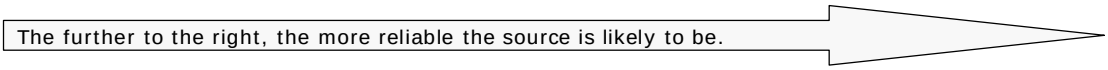
It would be most helpful for moderation if more annotation or commentary was provided for each candidate in the sample selected so that the moderator could more easily identify the evidence to support the Centre's marks. In many cases only the final mark awarded was recorded.

Strand A: Quality of selection and use of information

There was some evidence of improvement in the marks awarded for this strand compared to last year.

A(a): The key aspect here is for candidates to use sources of information to provide evidence for **both sides** of their case study. Websites from the internet were by far the most common source but many candidates referred to their course textbook and their own class notes to collect

information. The quality of extraction of information depends on careful selection of relevant extracts to quote directly, and the intelligent re-wording of content to bring out its relevance to the developing arguments in the study.
If no sources are credited then a maximum of 1 mark will be allowed by moderators, unless annotation confirms that a suitable range of sources were used. Higher marks require that sources represent a variety of different views or opinions, but there is not a 'magic number' of sources which divides 3 marks from 2; quality is more important than quantity. Only the better candidates, in addition to the requirements of 3 marks, attempted to assess their sources in terms of reliability in any rigorous and appropriate way.
For 4 marks it would be expected that candidates consider, for example, whether the source of information is from a 'respectable pressure group' or from the 'quality media' or a school textbook or science magazine, or a peer reviewed science journal or government report. Just saying' I think that the information is reliable because it is from the BBC' is not sufficient. The status of the author and the author's affiliation/institution should also be considered. Therefore if the source of information is a peer reviewed journal, written by a leading expert in the field who is based in a major university then it is more likely to be considered a reliable source. Those candidates who used the language and ideas from IaS 4 in discussing the reliability of sources such as ideas about peer review, the nature of the source or the status of the author, invariably achieved higher marks.



Publication	Website or newsletter of a private individual or a fringe group	Respectable pressure group website or newsletter	'Quality' media e.g. BBC, *The Times, The Independent, The Guardian, Daily Mail*	School textbook or science magazine e.g. New Scientist, Focus, Catalyst.	Peer reviewed science journal or government report
Nature of the data	Based on little or no data	Based on some data, but of questionable validity or reliability, e.g. small sample, not representative of population.	Based on just one study (or several small studies). Little information about sample, or procedures followed.	Valid and reliable method e.g. health study with large sample size, carried out over many years	Results repeated by different scientific studies, each using a valid and reliable method,
Science explanation	No support within the science community	New explanation, but with basis in accepted scientific ideas	One among several explanations discussed with the science community	Agreed by most, but not all, within the science community	Agreed by everyone within the science community
Status of the author	Someone who knows little or no science. Someone known to have a particular point of view	An inexperienced scientist or science student	A professional scientist whose expertise is in a different field	A professional scientist working in the area – though not regarded as a top expert by his/her peers	A recognised expert in this field of science
Author's affiliation or institution	A non-science institute	An scientific institute or company that represents particular views only	An scientific institute with a doubtful reputation	A recognised university or scientific institute	A leading university or scientific institute, or the research lab of a major company

A(b): The majority of candidates included a bibliography of sources at the end of their reports and most provided references to any websites that had been used. For 2 marks candidates identified their sources using incomplete references. In general, when applied to website addresses this meant that candidates referred to the homepages only e.g. www.bbc.co.uk. If only one or two incomplete references are given then one mark should be awarded and, of course, if no references are given then zero marks.
For 3 marks, candidates included complete references to the exact url address of the webpage which would allow direct access to the source of information. When referencing books, title, author and page references are required to match this mark. It was clear that more able candidates were including more detail, and this has begun to re-define the standard at 4 marks

for 2009. Candidates working at this level included the date that the site was visited and also some information about the nature or sponsorship of the site. For example, a candidate presenting a Case Study on cloning included the following reference: *http://exchanges.state.gov/forum/journal* and went on to explain that it was the US Bureau of Educational and Cultural Affairs and included information from the Advances in Biotechnology journal to provide teachers with resources about breakthroughs in biotechnology.

A(c): Candidates were still not very good at clearly showing where sections of text were directly quoted. It should be made clear to candidates that they are expected to copy some, reasonably short, material from their sources but it is essential that they make this completely clear. 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 included references or specific links within the text to show the source of particular information or opinions using, for example, numerical superscripts linking to references in the bibliography. Credit is given, not so much for the quotation, as for the editorial comment to explain why it was chosen, and how the candidate thinks it contributes to the arguments being compared in the study. If this referencing is not done, then candidates may also suffer in strand B, where they cannot easily show that they have recognised and evaluated the scientific content of particular sources, and in strand C, where they compare different opinions.

A number of candidates handed in full print-outs of their sources which was not necessary. Some candidates gathered information from self-constructed questionnaires which also added to the pool of material for their Case Study, but occasionally this distracted them from the underlying science and scientific evidence.

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 Studies

In simple terms, this strand assesses candidates' ability to consider the claims and opinions they have collected from their sources, to describe and explain the underlying relevant science, and to recognise and evaluate the scientific evidence on which the claims were based (IaS 1, 2 and 3). Those candidates who had clearly been taught IaS used the appropriate language and concepts, and achieved higher marks. However, there was some general improvement in this area compared to last year with more candidates including relevant KS3 and KS4 scientific ideas and targeting their report towards the suggested audience of intelligent Year 9 students.

B(a): The majority of candidates described in the introduction to their case studies the relevant background science, with the more able candidates going in to a greater depth and detail. However, most candidates did not go much further and it was only the most able who could link their scientific knowledge and understanding to the claims and opinions that they had found from their sources. Reporting was too often still at the 'headline level', simply repeating claims without looking beyond the headline for the underlying science.

For topics which are related to course modules, it can be taken as a general guide that 6 marks requires all that is available in available supporting text books. The 7^{th} or 8^{th} mark will come either for applying this correctly to the case, or for finding and explaining some more specialised knowledge (e.g. the way in which up to 8 mobile phones can "time-share" a single frequency to reduce total radiation loads and increase capacity).

B(b): This aspect focuses on candidates' ability to recognise and evaluate the scientific evidence that any claims and opinions are based on. Most candidates were able to recognise and extract relevant scientific content and data in their sources and were awarded 4 marks.

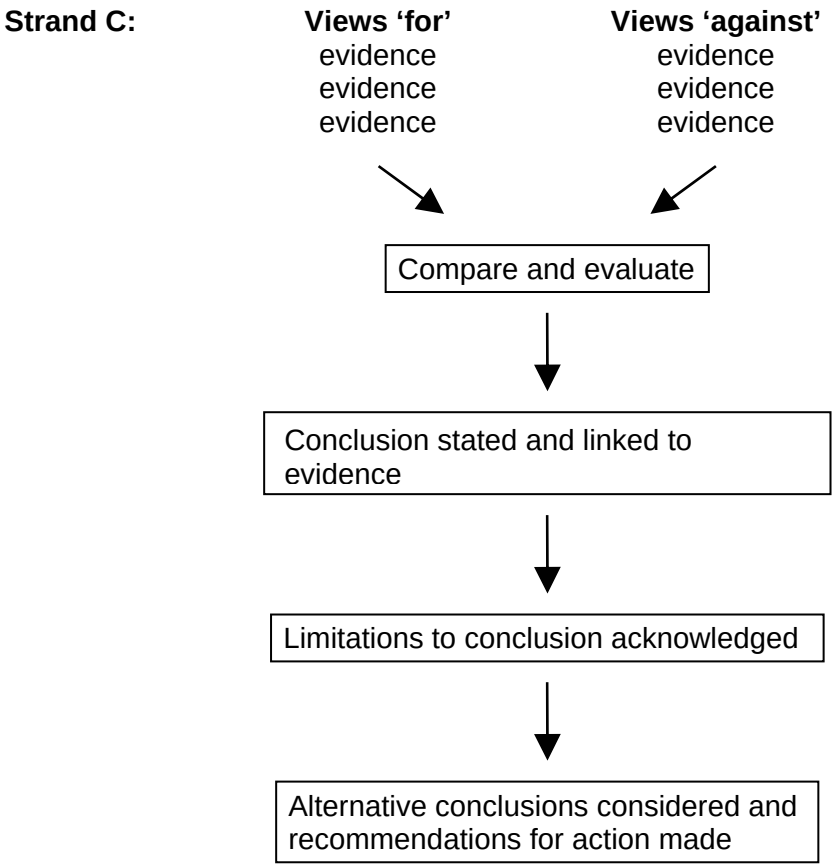
Candidates who were awarded 6 marks referred to the evidence base of the various claims and opinions, e.g. an experiment, a collection and review of existing data, a computer simulation etc. Candidates obtaining 7 or 8 marks looked more critically at the quality of the evidence. They used terms like 'reliability' and 'accuracy' when considering data, they looked at the design of experiments and the issue of sample size and they also compared the reliability of data between sources. For example, whether the evidence has been collected using a valid and reliable method, e.g. a health study with a large sample size over many years, or whether the results have been repeated by other people and the same conclusion drawn.
The information they find can be used towards credit for D(b) as well, if presented as graphs, charts or tables, or as informative schematic diagrams.

It was noted that in the Data Analysis component of this course, most candidates were able to some extent discuss and evaluate the data that they had personally collected in their practical experiments. However, in the context of the Case Study the vocabulary and use of terms from Ideas about Science were not used very frequently. Many candidates included tables/bar charts/graphs of relevant data but did not use or comment sufficiently on the information presented.

Strand C: quality of conclusions

In this strand, candidates should consider aspects of IaS 5 about actual and perceived risks and the ALARA principle and in IaS 6 about how society should respond. There was again evidence that candidates were not using and applying their 'Ideas about Science' sufficiently to warrant the higher marks in this strand.

The aspects for Strand C can be summarised in the following simple flowchart



Lower achieving candidates reported the information that they had collected without sorting it in any particular way and were awarded 2 marks. However, most candidates could sort the information that they had gathered into views 'for and against', sometimes in a tabular form if appropriate. Those who just listed it in this way were awarded 4 marks. Better candidates started to compare and balance arguments against one another in both their 'for and against' list and were awarded 6 marks. The best candidates began to analyse, compare and evaluate the claims and opinions, describing their own viewpoint or position in relation to the original question and justifying this by reference to the sources. There should be evidence that the sources used have been compared to check for consistency and to identify areas of conflict or disagreement. In this way it is clear that B(b) and C(a) are closely linked. There should also be evidence that the underlying science has been used to try to resolve any differences. Alternative conclusions should be considered where appropriate and recommendations for the future should also be included.

Several candidates scored less marks than they were probably capable of, particularly in Strand C, because they simply chose to report information about their topic, without any real analysis of the scientific evidence they were based on. Opinions from a variety of sources were often quoted but without reference to the source or to the evidence that the claims were based on. Although most candidates made an effort to give two different views in their studies, these were rarely compared, and conclusions often seemed to lack any clear basis in the evidence shown. This approach rarely leads to marks above 4 or 5. It was very rare indeed for even the better candidates to attempt any judgement of the quality or reliability of any of the scientific evidence offered by their sources. The best candidates will not simply state an answer to their own question ('I think mobile phones are dangerous', 'too much sun is bad for you') they will also use the evidence they have presented in their study as a basis for recommendations about what to do ('use a hands-free kit', 'text don't talk', 'avoid sunbathing at midday', 'wear sun screen' etc). Thus, the most successful titles were often questions where the answer would lead to some recommendations for action.

Strand D: quality of presentation

D(a): It was pleasing to see that the majority of reports included headings and/or sub-headings 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 to help guide readers quickly to particular sections. Those reports which were presented simply as PowerPoint printouts achieved good marks in this aspect but often lacked sufficient detail for high marks in the other strands. However, PowerPoint printouts which had notes to accompany each slide were much more successful in obtaining higher marks. It would be helpful for moderation purposes if these could be printed out in the format which gives one slide and the accompanying notes on a single A4 sheet. The slide can then concentrate on headings or visual impact, with the notes supplying the detail, references to sources, etc.

D(b): Suitable diagrams and graphics should be incorporated as appropriate to clarify difficult ideas and encourage effective communication, but in practice the visual impact was often variable. Too often images were decorative, rather than informative. Of course, many textbooks include decorative rather than always informative images and this may be a source of confusion for some candidates. A mixture of both is usually the best route to provide an interesting and informative report. Rather too little use was made of diagrams, charts, tables or graphs as compact ways of conveying large amounts of information, or to visualise difficult concepts. The best candidates always made good use of explanatory diagrams by referring to them and using the information that they contained. They integrated illustrations into their report, making comments about what was shown by the illustration, and how it was relevant to the study.

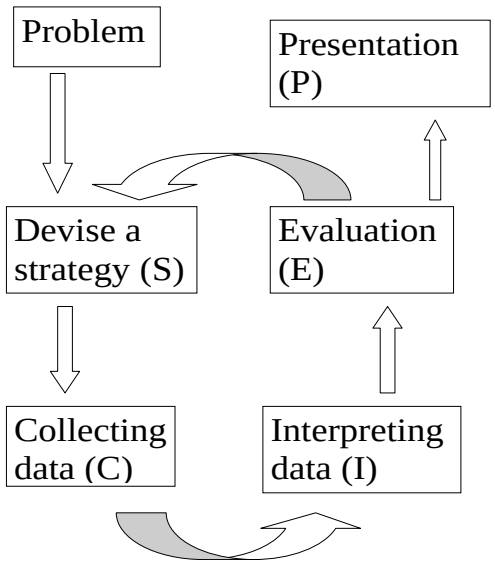
If there are no decorative or informative images included then zero marks is awarded. If one image is included, or a decorative front cover or other low level attempt to add interest is

present, then 1 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 illustrations, e.g. 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.

Some candidates included a useful glossary of scientific terms that had been used within the report.

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.

Strands I and E.
In general candidates achieved their poorest marks in these two strands.
See the detailed comments in the Data Analysis section.

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 threshold								
Component	**Maximum mark**	**A***	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Data Analysis and Case Study	16 + 24 = 40	33	29	25	21	17	13	10	7
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
Biology A (Specification Code J633)
June 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A*	A	B	C	D	E	F	G	U
A221/01	Raw	42	N/A	N/A	N/A	30	25	20	16	12	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A221/02	Raw	42	36	32	26	20	13	9	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A222/01	Raw	42	N/A	N/A	N/A	28	24	20	17	14	0
	UMS	34	N/A	N/A	N/A	30	25	20	15	10	0
A222/02	Raw	42	36	31	25	20	15	12	N/A	N/A	0
	UMS	50	45	40	35	30	25	23	N/A	N/A	0
A223/01	Raw	55	N/A	N/A	N/A	28	23	18	13	8	0
	UMS	100	N/A	N/A	N/A	60	50	40	30	20	0
A223/02	Raw	55	47	39	30	21	16	13	N/A	N/A	0
	UMS	100	90	80	70	60	50	45	N/A	N/A	0
A229	Raw	40	33	29	25	21	17	13	10	7	0
	UMS	100	90	80	70	60	50	40	30	20	0
A230	Raw	40	33	30	26	23	19	16	13	10	0
	UMS	100	90	80	70	60	50	40	30	20	0

A229/A230 (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 (ie after conversion of raw marks to uniform marks):

	Maximum Mark	A*	A	B	C	D	E	F	G	U
J633	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
J633	13.8	50.1	81.0	94.5	98.7	99.7	100.0	100.0	100.0	11 730

12 143 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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