Rewarding Learning

CCEA GCE - Biology
(Summer Series) 2012

Chief Examiner's and Principal Moderator's Report

Foreword

This booklet contains the Chief Examiner's/Principal Moderator's Reports for CCEA's General Certificate of Education (GCE) in Biology from the Summer Series 2012.

CCEA's examining teams produce these detailed reports outlining the performance of candidates in all aspects of the qualification in this series. These reports allow the examining team an opportunity to promote best practice and offer helpful hints whilst also presenting a forum to highlight any areas for improvement.

CCEA hopes that the Chief Examiner's/Principal Moderator's Reports will be viewed as a helpful and constructive medium to further support teachers and the learning process.

This report forms part of the suite of support materials for the specification. Further materials are available from the specification's microsite on our website at www.ccea.org.uk

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Subject Code 1010
QAN 500/2501/6
QAN 500/2503/X

GCE BIOLOGY

Chief Examiner's Report

Each of the four examination papers in summer 2012 provided further evidence of the high-quality learning and teaching taking place in centres taking CCEA A Level Biology. Reports on individual papers will comment in detail on issues relating to each paper but it is worthwhile commenting on some common features at this point in an attempt to encourage centres and candidates to further improve on the high standard set.

Candidates, in general, attempt all the questions; there was little evidence of questions, or question parts, not being attempted. However, the quality of answers relating to practical work is often disappointing; a comment that applies to all aspects of practical work including both interpreting and planning practical procedures. There was significant evidence of this in this suite of papers. For example, the planning of a sampling procedure in AS 2 (Question 6) was very poorly answered by many candidates suggesting that they had little experience of this type of technique in the field. Question 7 in A2 2, requiring an understanding of 95% confidence limits and their role in the analysis of data was only well done by a small number of the most able candidates.

As in recent years, there is significant evidence that many candidates are not secure in their knowledge and understanding of scientific terms or definitions. This knowledge will continue to be tested in all units in future series. Many centres provide candidates with glossaries of key terms in each topic or require their students to produce their own. This and other techniques used to improve knowledge and understanding of the key terms and concepts is only to be encouraged.

Additionally, many candidates lose marks through not answering the question as it is asked. Many questions, including those involving content familiar to the candidate, are applied in nature and therefore a suitably tailored response is invariably required. This comment applies across the suite of papers.

This year, following its introduction last summer, each of the papers had an 'extra lined page' to provide candidates with extra answer space without needing to resort to a supplementary answer booklet. It is pleasing to note that many candidates made use of this space appropriately, and when used, clearly indicated its use in the appropriate section(s) in the main body of the paper. However, there are still some candidates making unnecessary use of supplementary answer booklets; booklets that are often submitted unattached in any way to the examination paper. It is recommended that centres make all concerned, e.g. candidates, invigilators etc. aware of the extra lined page and the benefits of its use as opposed to the supplementary booklet.

A number of examiners have commented on the quality of handwriting by candidates this year. Many have to be commended on their high quality writing but a significant minority produce answers in writing that is so small, or barely legible, that it makes the examiner's role in identifying correct responses very difficult. While it is accepted that the quality of handwriting can deteriorate if candidates are under pressure of time to complete a paper, the evidence suggests that this is only a factor in a small minority of cases. A number of examiners also commented on the increased use of light or pastel coloured pens by candidates. This should be discouraged.

General Comments

The summer AS papers highlighted specific aspects of this cohort of candidates. Many candidates were well prepared exhibiting a high level of ability and a thorough preparation for the examination. They were able to show the breadth and depth of their knowledge across the AS content. However, it is certainly the case that some of the skills which are used in studying Biology at this level are much more highly developed than others.

Question parts testing practical work and skills, are an integral part of both AS papers. In AS 1 the use of reagents to identify biochemical substances was generally well understood. However, in AS 2 candidates were required to describe a random sampling procedure in prose and the majority struggled to do this. Perhaps it is the nature of the response required which throws candidates, so that short questions on practical procedures are much more accessible than responses requiring more extended writing. Questions of this type will continue to be a part of AS papers, since this is an essential aspect of any science course.

In both papers, candidates were asked to carry out tasks associated with data presentation. In AS 1, drawing skills were assessed and in AS 2 candidates were required to draw a graph using tabular results. It is pleasing to note that both of these skills appear to be very well developed, with most candidates scoring well in both of these question parts. In addition, both papers required interpretation and extraction of data from graphs: Q7 on AS 1 included a graph showing how free and immobilised enzyme activity varied with pH and on AS 2 a familiar graph showing pressure changes during the cardiac cycle formed part of Q4. It appears that skills in this aspect of graphical work are not so well developed, since there was much variation in the quality of responses to these question parts.

In both AS 1 and AS 2, there is evidence that the understanding and use of biological terminology lacks precision and would benefit from being given specific attention in many centres. For example:

- AS 1 Q1 'lamella' used in place of 'middle lamella'; 'ER' in place of 'smooth ER';
- AS 1 Q3 candidates unsure of the acronyms MRS, SNP;
- AS 1 Q4 confusion between 'lysis' and 'plasmolysis';
- AS 1 Q5 lack of accuracy with respect to 'chromatids', 'chromosomes' and 'bivalents/homologous chromosomes';
- AS 2 Q2 'excretion of enzymes' rather than 'secretion'; and
- AS 2 Q6 many candidates failed to identify the term 'edaphic'.

Finally, as is frequently the case, many candidates lost marks through their failure to read questions accurately and completely. Getting this vital part of their examination technique wrong results in lost opportunities to display their knowledge and understanding effectively. This is a particular shame for those candidates who have spent considerable time and effort learning factual material in preparation for the exam.

Assessment Unit AS 1 Molecules and Cells

This paper generated an extremely wide range of marks in the candidature and was successful in discriminating among candidates of different abilities. The paper enabled candidates to show the breadth and depth of their knowledge across the unit content. Some of the questions were more challenging than others, assessing more difficult concepts or the application of understanding to an unfamiliar situation (for example in part (b) of question 4).

Many candidates performed well, exhibiting a high level of ability and thorough preparation for the examination. In particular, it was pleasing to see questions involving practical skills being answered better than in several recent papers. However, questions involving biological terminology (for example, question 1) proved challenging for a large number of candidates.

It is also worth noting that there has been a continued decline in the ability of many candidates to express themselves clearly. While this may be penalised within QWC in section B, some ideas were so poorly expressed in Section A that marks could not be awarded, for example in questions 7(b) and (c). Many candidates, including some of the more able, had trouble with spelling and the appropriate use of scientific terms.

Yet again, many candidates penalised themselves by not reading the question stem sufficiently well or by failing to note all the information in the question.

Section A

Q1 This straightforward question on terminology relating to cell organelles proved very discriminating, with very few candidates achieving full marks. However, analysis of candidature performance showed that the mark distribution was normally distributed. Lack of precision caused many candidates to lose marks – for example, by giving 'lamella' instead of 'middle lamella' and 'ER' instead of 'SER'.

Q2 This question on use of reagents to identify biochemicals was much better done than in recent years, with the majority of candidates scoring at least three marks. It also discriminated well between candidates of differing abilities. Part (a) was generally well answered but part (b) showed a wide range of marks, with a small number of candidates unable to identify any of the four biochemicals.

Q3 This question, which tested knowledge of DNA structure and DNA profiling, was generally answered well. In part (a)(i) the majority of candidates failed to draw the new strand anti-parallel, while the majority of candidates scored full marks in part (a)(ii). In part (b) the majority could identify restriction endonucleases and electrophoresis, although the ability to spell these words proved very challenging for many. Part (c) proved difficult for many candidates, with a significant number of candidates unable to identify both markers.

Q4 This water potential question proved very discriminating, especially in part (a) and analysis of candidature performance showed that the mark distribution was normally distributed.

Part (a) was well answered by the majority, although many candidates only achieved 2 marks, as they did not explain the appearance fully. However, a significant number of candidates had not read the question stem correctly and so answered in terms of water leaving the cell instead of entering it. Also, a significant number of candidates showed confusion between the terms 'lysis' and 'plasmolysis'. It was pleasing to see that the majority of candidates were able to apply their knowledge of water potential to the

unfamiliar situation provided in part (b). While full marks were only obtained by the more able candidates, this section was very well attempted by the majority across the whole ability range.

Q5 This question showed a high level of differentiation, with few candidates scoring more than 7 marks. In part (a) a surprisingly large number of candidates could not identify the haploid number of chromosomes or the gender of the mouse, and many students seemed to think that the X and Y chromosomes were not to be counted.

Throughout parts (b) and (c) many candidates did not use the numbers of the phases as well as the names. Lack of precision also lost marks for many in part (b) – for example in part (i) 'separation of chromatids' was a common answer, rather than 'separation of the homologous chromosomes' and in part (ii) for descriptions of independent assortment there were many vague references to 'chromosomes' rather than 'bivalents/homologous pairs of chromosomes' being randomly organised. The term hydrolysis in part (c)(ii) was generally poorly explained – while many got the mark for 'addition of water' only very good candidates got the mark for fully explaining the breakage of large molecules into smaller constituent molecules. In part (iii) many candidates incorrectly gave an answer relating to chromosomes/chromatids, suggesting a failure to read the question stem at the start of part (c).

Q6 Drawing skills were tested in part (a). This was the first time in the new specification that the drawing was of a cell, rather than a block diagram of a tissue. It was well done by the majority of candidates of all abilities, although a number of candidates, having seen reference to a leaf in the question stem, attempted to draw a block diagram of a standard leaf. Labelling was generally good, with the most common errors being confusion between cell walls and membranes (in some cases with the membrane outside the wall) and between vacuoles and intercellular/air spaces. However, a significant minority, having drawn the cell shown, inserted labels appropriate to a leaf TS (such as xylem & phloem).

Part (b), concerning evidence from the photograph, was generally well done. However, many weaker candidates lost the epidermis mark by being too vague or by saying these cells had no chloroplasts, rather than epidermal cells would have had no chloroplasts.

While part (c), concerning the role of calcium and magnesium in the synthesis of substances found in plant cells was generally well answered it proved challenging for a significant number of candidates. Some candidates answered in terms of cell parts (for example, chloroplasts) rather than substances, while others who had not read the question stem, gave answers relating to the role of the minerals in animals.

Part (d) concerning differences between plant and fungal cells was very well done by the majority. It was pleasing to note that in answers relating to cell walls or storage compounds both parts of the answer were usually given.

Q7 While most of this question concerned enzyme action, part (a) was about lipids. While part (i) was generally well answered, a majority of candidates struggled with part (ii), with the most common incorrect answer being a ratio of 1:4.

The rest of the question highlighted the problem many candidates have with reading all pieces of information that is given to them and it was an excellent question for discriminating between candidates of different abilities.

In part (b)(i) answers tended to lack detail and many candidates achieved only 2 marks. Commonly, candidates had picked out their answer from the question stem and so

gave a general description of the washing process rather than the question asked. At this level we should be expecting all candidates to use terms such as 'complementary shape', 'enzyme-substrate complex', 'activation energy' but this was not often the case. While part (b)(ii) was generally well answered, a significant number of candidates gave vague answers, for example 'heat changes the shape of the enzyme' rather than specifically referring to the shape of the active site.

Part (c), concerning enzyme immobilization, showed a high level of differentiation between candidates. It was well done by many but vague answers lost marks for a significant number of candidates. In part (i) some candidates did not clearly state that the activity of the immobilised enzyme was greater over a wider range – instead they simply stated it worked at a wider range (which is not the case in this graph). In part (ii) explanations of the differences shown in the graph were also often too vague (for example, vague references to enzymes not being able to move). Yet again, a surprising number referred generally to increased thermostability (when the question was about the effect of pH).

Section B

Q8 This prose question required candidates to describe similarities and differences between the structure, role and distribution of three polysaccharides (starch, glycogen and cellulose). It proved very discriminating, with a wide spread of marks. There were some very high calibre answers, although only a minority achieved full marks, largely due to the inability of many candidates to link their ideas successfully. Only a very small number of candidates were awarded 0 marks and this was mainly due to not attempting the question at all.

The first part of the essay was very well answered, with many very good candidates achieving full marks. Some candidates included some aspects of the role and distribution throughout their answer to structure and then did not repeat these points in the second section (role and distribution) so they did not get awarded the marks. However, marks for the second section were more commonly lost by candidates failing to link the properties with the role – for example 'branching with compact', 'more terminal ends (most candidates simply referred to branching here) with hydrolysis' and 'insolubility with being osmotically inert/unable to leave cell'.

Quality of written communication was often good, with many well-sequenced accounts that incorporated sound biological terminology. However, it is an area where standards would seem to be slipping; many candidates lost marks due to poor sequencing or to partial answers. Perhaps more emphasis on doing a brief 'essay-plan' would help in this area.

Assessment Unit AS 2 Organisms and Biodiversity

This was a paper which allowed candidates of all abilities to demonstrate their differing levels of knowledge and understanding of biology. A wide range of marks was achieved, reflecting the accessible yet discriminating nature of the questions. The paper included a range of stimulus material, including prose (Q2), graphs (Q4), photographs (Q6) and other images, as well as a table (Q7). The paper covered both theory and practical aspects of the course and required successful candidates to demonstrate a variety of skills.

Two aspects of performance were of particular note. Firstly, the standard of graphical drawing (Q6(c)) was excellent, reflecting the diligent and persistent efforts of both candidates and

teachers. On the other hand, the ability of candidates to describe a practical procedure was poor, on the whole (Q6(a)) and raises some concern regarding the opportunities for candidates to carry out practical investigations. This is an integral part of the specification and as such should be given equal weighting in terms of the delivery of the course content. Often the descriptions given were extremely vague and as a result marks awarded were low. This is a fundamental skill at AS level and should be addressed as an area of weakness.

Section A

Q1 This question should have been straightforward, but instead proved challenging. Part (a) was generally well done, but too many candidates, in answering part (b), failed to reference the starting colour of bicarbonate indicator and consequently lost two marks. (This has been highlighted in previous reports). Others simply did not know the colour change or mistakenly referred to the change in limewater, from clear to cloudy.

Q2 This question was well answered, with a full range of marks being awarded. Part (b)(i) proved to be discriminating in terms of the level of accurate detail provided by candidates. For example, some lost a mark for stating that hydrolytic enzymes were *excreted* out of the hyphae. In addition, few candidates correctly suggested an enzyme produced by *Marasmius oreades* which would not be produced by animals part (b)(ii), but better candidates were able to give the correct answer cellulase.

Q3 Part (a) required candidates to apply knowledge of Fick's Law in the unfamiliar context of fish gills. This part was not well answered, with a majority of candidates simply restating the components of Fick's Law while failing to suggest a feature of gills which might help them to maximise gas exchange. The most common correct answer was that gills would be expected to have a thin structure in order to minimise diffusion distance. A few very able candidates suggested folding or evagination of gills to achieve a large surface area, and some also suggested the proximity to a good blood supply and/or a means of ventilation to maintain a high concentration gradient. A significant number erroneously referred to gills being moist, which of course is true and unavoidable in an aquatic habitat, but is not related to Fick's Law. Part (b) was generally well answered.

Q4 This question covered both the mechanism of breathing and the cardiac cycle, under the umbrella of mass flow. Part (a) was quite well answered with appropriate AS level detail, as required by the mark scheme. So, for example, candidates only achieved credit for stating that the volume of the chest or thorax increased during expiration, and not that of the *lungs*; it was also necessary to state that *both* the diaphragm and (external) intercostal muscles relax during expiration. Too many candidates still demonstrate confusion with respect to cause and effect in this process, wrongly stating that the volume of the thorax decreases *as a result of* air being forced out (in the same way that air being sucked in would increase the volume of the thorax).

Part (b) involved interpretation of a standard graph showing pressure changes during a cardiac cycle. Responses to this part indicated that a significant number of candidates do not understand the graph nor the causes of pressure changes within the heart. Many failed to identify correctly the letters representing opening and closing of valves part (b)(i). In addition, it was by no means the case that candidates who identified one event also correctly identified the other, demonstrating that this is indeed a higher order skill. Responses to part (b)(ii) were also highly variable in accuracy and the

correct use of terminology, reflecting an inadequate understanding of the graph and how it relates to the events of the cardiac cycle. A common error involved attributing the increase in atrial pressure to its filling with blood, rather than atrial systole.

Part (c) was generally well answered, reflecting a good knowledge of terms used to describe aspects of the cardiac cycle. Part (d) was also well answered, which was pleasing considering the irregular ECG is relatively unfamiliar and interpretation of this was required. Often, candidates who had not scored highly in the rest of the question managed to correctly interpret the ECG. The most common error involved making reference to the heights of the peaks, rather than the intervals between them.

Q5 This question on plant transport tissues involved interpretation of photomicrographs of xylem and phloem tissue. Many candidates demonstrated sound skills in this area, including their knowledge of both structure and function of xylem and phloem. Again, parts of this question proved to be accessible to those who perhaps had limited factual knowledge of the topic: these candidates often were able to indicate the direction in which the stem had been cut (c) and to calculate the actual length of the sieve plate (e). These are important skills which should be rewarded. In the calculation, the most common error involved the process of unit conversion, which many find difficult. This can be compounded by the fact that many candidates insist on working with measurements in centimetres, rather than millimetres, which undoubtedly makes processing errors more likely.

Q6 This question was concerned with practical ecology. As highlighted already, describing a procedure by means of an ordered sequence continues to provide a challenge to even the most able of candidates. Very few achieved 4 marks in part (a) of this question. This type of question has been set on several previous occasions, with variations in habitat and sampling protocols, so candidates should now have a bank of questions and mark schemes to consult in order to help them develop this skill. They must be encouraged to think through the actual steps involved in a procedure and avoid writing the vaguest descriptions which could barely be described as a 'method'. In reading the responses to this part, one is often left asking, "But what would you actually *do*?" In addition, candidates must be aware of the need to read through all of the information provided in order to determine which kind of sampling procedure is valid. In this case, too many saw only the sand dune graphic and went on to describe a systematic sampling technique along a belt transect from seashore to woodland. This is not appropriate, since the question clearly asks for a random sampling method to study only one dune ridge and dune slack.

Perhaps there has been a reduction in the opportunities for centres to take part in fieldwork and this has resulted in a lack of familiarity with procedures. However, this can only be partly to blame for the poor performance in this question part, since past experience suggests that candidates find it just as challenging to describe the procedure for a lab-based practical such as the osmosis/potato experiment. Whatever the cause, the difficulty should be addressed in centres.

In part (b), which was generally well answered, the most common error involved ignoring the fact that the soil samples were *repeatedly* heated and reweighed, and simply stating that the aim was to measure soil moisture. Of course, this was in the question stem. In part (b)(ii), many more candidates were able to give an example of an edaphic factor than were able to correctly state the term.

As noted, the skill of graph drawing part (c) was demonstrated to an excellent standard by the candidature, with many scoring at least 3 out of 4 for this part. Captions, axis

labels, accuracy of plotting were completed to a high standard. The most common reason for losing a mark was drawing the wrong type of graph, usually a histogram (less often a line graph), rather than a bar chart.

Part (d) was generally well done, although many candidates were guilty of only half-reading the question stem. As a result, they answered the question 'Explain how the presence of rabbits may affect the distribution or abundance of vegetation', rather than what was asked.

Q7 This question involved the presentation of novel information, in both prose and tabular forms, which candidates were required to read for understanding. The question was accessible while being discriminating at higher levels, with most candidates achieving 5–8 marks out of a possible 10. Part (a) showed much variation in terms of marks awarded, with good candidates achieving the full 3 marks. Most candidates were able to identify 'phylum' as the missing taxonomic rank and to state the genus and species names of *Sciuris vulgaris*. Extracting information correctly to identify the class, order and family of the animal proved more of a challenge. In part (b)(i), most candidates achieved 1 or 2 marks, usually by noting the higher reproductive capacity of the grey squirrel and/or its more varied diet. Better candidates achieved 3 or 4, usually by going on to note the grey squirrel's stocky shape and the advantages this would confer. In part (b)(ii), the most common error was failing to give both an aspect of design/placement for the hoppers *and* an explanation for this.

Section B

Q8 This proved to be a very discriminating question, where those candidates with a detailed factual knowledge of blood cells could shine and those whose knowledge was only minimally above GCSE standard could achieve very few marks. A wide range of marks were awarded for this question, with modal scores being in the region of 10–13. It appears that detailed knowledge of white blood cells can be expected of the candidature, but less so the cascade reaction of blood clotting and less again the adaptations of erythrocytes. The latter is an area where many candidates gave responses which showed little or no progression from GCSE knowledge.

Principal Moderator's Report

Assessment Unit AS 3 Assessment of Practical Skills in AS Biology

As with previous years, work submitted by most centres continues to be of a high standard and most practical's come from a narrow range; water potential, enzyme investigations and membrane permeability being the most common. Moderation was greatly aided by the inclusion of centre based mark schemes and clear teacher annotation and there were fewer centres not following CCEA guidelines with regards to the submitting of coursework. Teachers should be fully aware of the need for signatures, both teacher and candidate, on the CRS.

Teachers should also be aware of the requirement for internal moderation and standardisation so that a consistent approach by teachers within individual centres is achieved.

Many centres used a template to help the candidates to structure their work. However, it is essential (as was mentioned in the CCEA circular) that this is restricted to headings only using

the assessment criteria. Too often candidates were directed by questions to give the correct reply without using their own thought processes in the construction of responses.

Whilst marking of work has improved the moderation team still feel too many candidates are awarded two marks even though clear errors were evident in their responses. This will lead to more centres being outside of the allowed tolerance.

Implementation

Candidates follow an appropriate procedure given by the teacher which should enable the candidate to investigate a given hypothesis. In some cases candidates were just asked to investigate a particular factor without reference to a specific hypothesis. All candidates (or groups) should carry out the full range of the independent variable (I.V.) and not just one value. Marks should be deducted here if results are not measured with the required degree of precision e.g. some results only measured to one decimal place whilst others are to two.

Recording & Communicating

This skill area has improved, however, there are still discrepancies between marks awarded by teachers and the standards expected by the moderation team. Captions for both graphs and tables, whilst containing all the necessary information, are often too wordy or worded incorrectly e.g. % transmission of beetroot is frequently reported rather than transmission through a beetroot solution. Distilled water is often plotted on the x axis rather than a molarity of 0 and best fit lines are often of poor quality. These errors should all be penalised.

Interpretation

In most centres this section tends to be of a high standard although in many instances much too long. Many centres have marked this in two sections; written communication and trend out of 4 marks and the explanation of the trend using biological knowledge out of 4 marks. This is acceptable as long as it is marked correctly. It is important for centres, especially those new to AS level, to ensure marks are awarded at an appropriate level for AS, i.e. would a response get equivalent marks in an exam.

Evaluation of the Design

This section continues to give the greatest degree of differentiation within a centre and between moderator and teacher. The appropriateness of the measurements should reference more clearly the degree of accuracy or the instrument of measurement used, e.g. why is a colorimeter used? Why are masses to two decimal places used?

The validity of the experiment is still not well understood by candidates and in many cases a simple statement of "we found what we wanted therefore it is valid" and this is not acceptable for two marks. In most of the practical work carried out for coursework there are reasonably clear factors that could not or were not controlled and therefore would affect validity.

Assessment of the variation of the results should refer directly to the pooled results (inclusion of examples would help to illustrate this) and should not simply be a range calculation. Clustering or lack of clustering of the results should be used to give an indication of the variation and then the degree of variation should be linked to the extent of the reliability of the results and thus whether further replication would be necessary.

Chief Examiner's Report

Assessment Unit A2

General Comments

It is pleasing to note that the A2 papers in summer 2012 provided evidence of much high quality learning and teaching in 'A' level Biology. There is clear evidence that many candidates are able to cope comfortably with the significant increase in demand between AS and A2 level.

In both A2 papers it is very apparent that many candidates lost marks through not reading the question properly. Mark schemes inevitably reflect the question as it is asked and will reward marks accordingly. When a question asks the candidates to use the information provided they must use this information in an appropriate manner to access the full range of marks available. The increase in the requirement of an ability to apply knowledge at A2 depends heavily on the ability of the candidate to analyse information and clearly identify the requirements of a particular question as it is asked.

As in most years, the top candidates were distinguished by their ability to use 'A' level terminology comfortably and were secure in their factual knowledge. While the A2 papers contain significant applied material many marks are available for (relatively straightforward) knowledge and understanding. This will continue to be the case.

Synoptic assessment is an element that will always be present in A2 papers. Candidates should be aware that synoptic questions will be invariably set in context of the A2 topics that are being examined in the paper. Furthermore, synoptic questions can involve practical techniques and experimental procedures as well as content.

Assessment Unit A2 1 Physiology and Ecosystems

This was the sixth A2 1 paper in the new specification with a mean very similar to those of previous papers. Responses were normally distributed across the candidature and there is clear evidence that it discriminated effectively between the candidates. There were some excellent responses although only a very small number of candidates obtained more than 80 raw marks in the paper, a feature common with recent A2 1 papers.

However, it is pleasing to report that very few candidates scored less than 20 marks with no candidates registering in single figures.

Section A

Q1 This question required knowledge of plant hormones and their functions. This question was well answered by most candidates with four or five marks being the most common marks awarded. Only a very small minority of candidates failed to obtain at least three of the five marks available. In part (a) a significant minority of candidates failed to explain the function of cytokinin fully through providing an unqualified 'cell division' as their answer. It was essential that candidates gave some indication that cytokinin *promotes* cell division – as has already been noted, this lack of attention to detail by some candidates is a common thread running through the suite of papers. Although part (b) was well answered, many candidates failed to pick up all three marks available through not describing the reason for the corkscrew appearance of the plant.

A significant minority of candidates referred to it being a consequence of the daily movements of the Sun. The most able candidates were able to relate the appearance of the plant to a series of phototropic responses linked to the fact that the plant was not turned often enough.

Q2 This question was also very well answered with the significant majority of candidates obtaining five or six of the six marks available. Part (a) was very well done with almost all candidates being aware of the cause of the striated appearance of skeletal muscle. Part (b)(i) was less well done with a significant number of candidates not being able to distinguish between the nervous control of the iris and that of skeletal muscle. While a number of appropriate responses were allowed, only the more able candidates used the term voluntary to describe the control of skeletal muscle – the term used in the specification. Part (b)(ii) was well answered by many candidates although a surprisingly high number confused the roles of circular and radial muscles. A significant minority of candidates confused the role of the iris in controlling light intensity in the eye with accommodation. As always, the very able candidates provided accurate and complete but succinct accounts providing both the action of the appropriate muscles and their role in the functioning of the iris as required. Part (b)(iii) was quite well answered with most candidates answering the ciliary muscle correctly.

Q3 This question on energy transfer in an agricultural ecosystem proved to be more discriminating. Although seven marks were available for this question, five marks was the mark most commonly awarded to candidates. In part (a)(i) the calculation of sunlight trapped as GPP was well answered with many candidates giving their answer correct to two decimal places. Similarly, parts (ii) and (iii) were well answered. Part (b) proved to be effective in discriminating between candidates of different abilities. A good number of candidates were able to obtain the evidence from the diagram that identified it as being from an agricultural based ecosystem but only a very small number were able to provide the reasoning required.

Q4 This question, involving the use of a photomicrograph showing a motor neurone cell, neurotransmitters and peer review, also proved to be an effective discriminator. Candidate performance was normally distributed around a question mean of six (out of eight marks available). Most candidates were able to identify the features labelled in the photomicrograph correctly in part (a)(i). However, the identification of the part of the body that the photomicrograph could have been from proved to be much more demanding with muscle proving to be a common incorrect answer.

Part (b)(i) was very well answered by the most able candidates with an excellent understanding of the depolarisation of the post synaptic membrane frequently displayed. However, a significant number of candidates failed to state the primary function of neurotransmitters – that of transferring impulses from neurone to neurone (muscle). Many of the candidates who failed to obtain any of the two marks available for this question part did not focus on the question as asked and answered about the nervous system rather than neurotransmitters.

Part (b)(ii) was often well answered showing that many candidates understand the link between sample size and reliability. Part (b)(iii) was novel and a significant majority of the candidates obtained at least one of the two marks available, focusing on the benefits of peer review on checking accuracy/validity/reliability of investigative work. The more able candidates were often able to develop their answers to explain that review of research of this nature required that the reviewer be a scientist/specialist in order that the research can be reviewed with the level of rigour required. There were

some excellent answers with candidates explaining that peer review also facilitates the transfer of knowledge between specialists and that this can contribute to the development of the theory.

Q5 Question five, which focused on the capture–recapture technique as its central theme also effectively discriminated between candidates. Again, question scores were normally distributed with most of the candidates scoring between six and ten of the thirteen marks available. Only a very small minority of very able candidates achieved all thirteen marks in this question.

In part (a), only those candidates who correctly focused on the three key areas identified in the stem of the question, namely "the sampling procedure used", the "technique used to capture the insects" and the "marking procedure" tended to obtain the four marks available. Many candidates concentrated on sampling procedures and barely touched on the other two areas, consequently limiting their achievement in this question part.

Parts (b)(i) and (ii) were well answered by the majority of candidates. Part (c), a calculation of Lincoln index from data provided, proved to be more discriminating than expected. Those candidates who knew the required formula and could apply it found the question straightforward but many appeared not to remember the formula and consequently could not complete the calculation.

Part (d) was well answered with many candidates demonstrating good understanding of the type of information required before deciding whether the grasshopper species should be given special protection. Part (e) was much more discriminating, although a significant minority of candidates obtained all three marks available. This question part was clearly synoptic and only the more able candidates were able to link the raised body temperature (a direct consequence of incident heat from the Sun) to increased enzyme/metabolic activity and the benefits that this could produce.

Q6 This question provided a number of applied sub-parts relating to the carbon cycle. Again, analysis of candidature performance showed that the mark distribution was normally distributed.

Parts (a)(i) and (ii) appeared straightforward but a significant number of candidates failed to obtain the marks available. In part (ii) many candidates confused light with heat and only the top candidates tended to make reference to long wave radiation. Part (a)(iii) was generally well answered with almost all candidates gaining at least one of the two marks available.

Part (b) was very well answered by the more able candidates who were able to demonstrate very sound understanding of the processes involved and were able to tightly align their responses to the requirements of the question as it was asked. Weaker candidates tended to drift from the requirements of the question and gave general, but vague, accounts of the effect of man on global warming.

Q7 This question on osmoregulation proved to be demanding for many candidates with typical responses gaining between four and eight of the eleven marks available. Only the very top candidates obtained ten or eleven marks in this question. Consequently, as with most questions in the paper, there was effective discrimination between candidates of different abilities.

Part (a) proved to be accessible for most candidates but in part (ii) a significant number provided answers along the line of the glucose being easy to *digest*, an incorrect response which naturally failed to gain credit.

Many candidates lost marks in part (b) for incorrectly stating that water moves from a low water potential to a high water potential. It is pleasing to note that an increasing number of candidates are answering questions of this type in terms of water potential but a disappointing and significantly large number of candidates are not secure in their knowledge and understanding concerning the key concepts of this topic.

Part (c) provided the full range of responses. Only a very small number of candidates answered the question exactly as it was asked, i.e. the effect of an isotonic drink entering the body. However, candidates were given credit for good understanding by comparing the effect of the isotonic drink as compared to taking in water.

Part (d) was synoptic requiring knowledge of sugar absorption in the ileum. In part (i) many candidates were able to make reference to facilitated diffusion or active transport being involved in sugar absorption but a much smaller number made reference to the role of carrier proteins in the process or the role of the capillary network. In part (ii) many candidates gained the first mark through answering that both villi and microvilli increase surface area. The 'difference' mark was much more discriminating with credit not being given for only a general reference to difference in scale. Only the top candidates provided the detail required answering in terms of microvilli being sub-cellular and villi being much larger structures consisting of many cells.

Q8 Question 8, covering a range of aspects of crop growth and the effect of pests proved to be the most demanding question in the paper. Analysis of candidature response indicates that marks awarded were again normally distributed with the large majority of candidates gaining between five and nine of the thirteen marks available. In part (a)(i) a significant majority of the candidates gained the first mark through identifying the correct value for optimum application of fertiliser but only a very small number gained the second mark through making reference to the economic benefits of using, and not exceeding, the optimum value.

Part (a)(ii) was well answered only by the more able candidates, with vague answers being more common. Part (iii) proved to be disappointingly done with many candidates failing to explain fully the benefits of an improved soil crumb structure. Common answers were improved aeration and drainage but a majority of candidates failed to go on to explain the benefits of the improved aeration and drainage.

Part (b)(i) was well answered with most candidates having a good understanding of the ways in which pests can reduce crop yield. Part (b)(ii) requiring both the analysis of a graphical representation of the effect of successive pesticide applications on a crop and an understanding of pest resistance was well answered by many candidates although only the top candidates obtained all four of the marks available. Candidates often lost marks through failing to identify more than one trend in the graph or through a poor understanding of the concept of pest resistance. They often mixed up the terms resistance and immunity showing a lack of understanding that resistance is passed on genetically through the generations. Part (c) was usually well answered.

Section B

Q9 The essay on immunity was generally well answered. While responses from candidates provided a wide range of marks, the more able candidates were able to obtain full marks. The difference between antibody-mediated and cell-mediated immunity is well understood and it is pleasing to record that many candidates provided excellent answers showing a detailed knowledge and understanding of the processes involved in

both immunity to infection and transplant rejection including the measures used to reduce rejection.

Assessment Unit A2 2 Biochemistry, Genetics and Evolutionary Trends

This was the third paper in the new specification assessing this unit. The paper contained a balance of familiar and unfamiliar content with a range of skills being tested as is to be expected based on the requirements of the specification. As in previous A2 2 papers, candidates can expect to find question(s) covering an aspect of statistics and other 'process' type questions as exemplified by question six involving genetics.

This paper provided very obvious discrimination across the candidate range. The paper mean was very similar to the 2011 mean with a significant number of candidates scoring in excess of 80 marks and a small number of very able candidates obtaining more than 85 of the 90 available marks. The exceptional performance of the top candidates is a credit to all concerned, particularly in the context of a demanding paper. There is some evidence that a number of candidates found the paper demanding in terms of completing their answers in the time allocated.

In the A2 2 paper candidates can expect elements of synoptic assessment and that this can involve A2 1, in addition to AS content. With no 'synoptic' paper as such in the current specification, it is a requirement that the A2 papers have synoptic assessment.

Detailed analysis of candidate performance indicates that many candidates find the application of knowledge difficult when set in novel contexts. Again this is a requirement and is an appropriate means of testing important scientific skills that need to be developed and fine-tuned during the A2 course.

Section A

Q1 This question, on gene interaction proved to be very difficult for many of the candidates. Statistical analysis of candidate performance indicates that this was the most poorly answered question on the paper which was a disappointing outcome for all concerned. A significant majority of candidates scored nothing or only one of the three marks available. A disappointingly large number of candidates clearly demonstrated lack of understanding between the terms gene and allele and many demonstrated little understanding of the concept gene interaction. Many candidates scored one mark for demonstrating an understanding of epistasis. This question, as much as any in the paper, demonstrated the lack of detailed knowledge and understanding of scientific terminology that many candidates possess. Nonetheless, on reflection, the examining team accepts that this question perhaps did not provide the type of 'settling in' question that is ideally present at the start of an 'A' level paper despite it being 'knowledge recall'.

Q2 This question covering adaptations in bracken and cnidarians was much better answered with the candidate responses showing a normal distribution.

Part (a)(i) was well answered with a majority of candidates being able to explain why sexual reproduction in ferns is moisture dependent. Part (a)(ii) was also quite well answered although a significant number mixed up rhizomes with rhizoids. In part (a)(iii) there were some very inventive suggestions showing that candidates were able to 'think outside the box' and apply their understanding very effectively.

Part (b) was also well answered although a number of candidates appeared to think that cnidarians were plants. Another frequent cause of lost marks was that some candidates failed to link their answer to the cnidarians' requirement for water.

Q3 This question on protein synthesis was generally well answered. A large majority of candidates scored seven or more of the eleven marks available. Most candidates scored well in part (a)(i) which was worth four marks and also in part (a)(ii) which was worth two. Many descriptions of transcription were excellent and the structural differences between DNA and RNA were accurately identified. However, a number of candidates confused the enzymes involved, e.g. DNA polymerase with RNA polymerase.

Part (b) proved to be more demanding for many candidates with only a smaller number being able to explain why the 'one gene – one polypeptide' is the accepted theory for gene action. A relatively small number of candidates grasped the idea that proteins can be made from several polypeptides and even fewer could relate that not all proteins are enzymes. A straightforward calculation in part (c)(i) allowed the majority of candidates to calculate that 252 base pairs would be required to code for 84 amino acids but a smaller number were able to go on to explain that parts of the DNA were non-coding in part (ii). Answers relating to the degenerate code were common incorrect answers.

Q4 In this question, candidates were given information about the experiments conducted by Melvin Calvin, using radioactively labelled carbon to elucidate the sequence of reactions in the light-independent reactions of photosynthesis. It proved to be a discriminating question with only the best candidates scoring well. The mark range of candidate responses was normally distributed with a majority of candidates obtaining between five and eight of the twelve marks available.

In part (a)(i), glycerate phosphate was usually correctly identified as the first compound. However, relatively few were able to explain the trends evident in the graph in part (ii) or why it was necessary that the period of exposure of *Chlorella* to radioactive carbon dioxide was increased incrementally by only a few seconds each time (part (iii)). While candidates are familiar with the steps of the cycle a significant number had little understanding of the concept of an ongoing cyclical process with all stages occurring simultaneously. Additionally, many candidates appeared unable to understand the process or significance of radioactive labelling.

Part (b) provided better responses from weaker candidates but while a significant number could recognise that respiration and photosynthesis were in equilibrium at points Y in part (b)(i), many could not remember the term compensation point. Part (b)(iii) was well answered by many candidates but only the top candidates obtained all four marks. A significant number revealed a lack of understanding of the concept of limiting factors and how that knowledge can be used to maximise photosynthesis rates.

Q5 This question on gene technology produced the full range of marks. The topic was well known and candidates had a number of opportunities to repeat learned points. In part (a) the majority of candidates were able to explain how plasmids are used as vectors but their definition of a plasmid was often too vague.

Part (b) was well done with a majority of candidates being able to explain how a human gene can be obtained and inserted into a plasmid.

In part (c)(i) most candidates could describe how bacteria could be encouraged to take up recombinant plasmids. Part (c)(ii) requiring understanding of replica plating

provided more mixed responses with a significant number of candidates using ampicillin in their answer showing confusion with a past paper question. As noted elsewhere, this highlights the issue created by many candidates learning set answers rather than treating each question on its merits and reading the stimulus material fully. However, the more able candidates were able to show clear understanding of a difficult practical concept.

In part (c)(iii) only the more able candidates were able to answer the question in terms of less competition for the transformed bacteria or by reducing the level of downstream processing required.

Part (d) requiring health and ethical advantages of using bacteria to produce insulin was well answered.

Q6 This question involved a relatively straightforward genetics pedigree. The more able candidates were able to obtain nine or ten of the ten marks available but a significant minority of candidates obtained around half or less of the available marks.

Part (a) was well answered and many candidates were able to explain effectively that haemophilia is a recessive, sex-linked condition. However, in part (b) relatively few candidates were able to carry this information through and correctly identify the genotypes of individuals 2 and 4 – with the sex chromosomes of the individuals often omitted.

Part (c) proved to be very discriminating with only the more able candidates able to complete the dihybrid cross involving sex linkage (two separate genetic crosses for each of albinism and haemophilia, followed by working out the probability of having a male child with both conditions was also awarded full marks, but was a less frequent route taken by candidates – most good answers involved a dihybrid cross). There was frequent evidence of candidates attempting but not completing the cross. It was very evident that while many candidates were aware that part (c) involved a cross involving sex-linkage, many struggled to carry this out in practice. Part (d) was generally well known.

Q7 As the final question in Section A, this was a difficult and complex question which proved to be discriminating as expected. Candidate responses were normally distributed although only a small number of very able candidates obtained twelve or more of the fourteen marks available.

Part (a) was quite well answered but a small number of candidates misinterpreted the question and listed controlled variables.

In part (b)(i) a very small number of candidates completed the calculation correctly but the use of non-consequential marking often allowed one or two marks to be obtained. The main problem was identifying the number of degrees of freedom to use – d.f. values of 4 or 5 (as opposed to 9) were very frequent. Additionally, many candidates carried out the calculation on the basis of 0.442 being the standard deviation rather than the standard error. There were many scripts with this section omitted completely. Where limits were calculated, they were generally correctly plotted in part (b)(ii). Many candidates did well in part (b)(iii) but a considerable number were not clear concerning the relevance of overlapping, and non-overlapping 95% confidence limit bars.

Part (c) was well answered by the most able candidates who were able to apply their knowledge effectively. It was very evident that only candidates who assimilated the information in the question stem concerning anti-fungal activity in plants effectively provided focused and well thought out answers.

Part (d)(i) was answered correctly by the majority of candidates but part (d)(ii) was much more discriminating. This question, being synoptic and involving a high degree of application, asked candidates to suggest how a large earthworm population and their network of burrows could promote the recycling of nitrogen. Very able candidates were able to access the four marks available but many of the weaker candidates failed to pick up any marks at all in this section.

Section B

Q8 The full range of marks was obtained by the candidature in this question but it did provide an opportunity for able candidates who had a sound knowledge and understanding of the biochemistry of respiration and photosynthesis to do well. It is pleasing to note that a significant number of candidates obtained seventeen or eighteen marks. Those candidates who did less well tended to do better in part (a) than part (b). In part (a) a significant number of candidates failed to focus their answer to the requirements of the question with many appearing to describe all they knew about respiration and photosynthesis, accounts which often covered three or more pages. Inevitably, this coupled with the overall demands of the paper, meant that these candidates were short for time when answering part (b) or even for going back and reviewing the paper as a whole. Perhaps, as already mentioned in the comments on the AS Section B, this lack of focus and feeling of 'time-pressure' could be helped by placing more emphasis on doing a brief 'essay-plan' in order to help sequence answers and to reflect the question, rather than the topic, more directly. Part (b) was much more discriminating with only the more able candidates obtaining full marks in this section.

Principal Moderator's Report

Assessment Unit A2 3 Assessment of Investigational and Practical Skills in Biology

There has been an increase in the variation in investigations being submitted at A2 level and this is to be encouraged. However, it is important that the investigation allows the candidates to access all of the marking criteria at a standard appropriate to A2 Level. The main issue for concern amongst the moderation team is the amount of guidance being given to the candidates. It has been found that candidate responses across several teaching groups are very similar in their wording and are also very similar to the centre based mark schemes provided. Writing frames should only contain the assessment criteria thus avoiding directing the pupils to the right answer. In addition to this, we are too frequently seeing 2 marks awarded where criteria has been met to some degree but perhaps not in sufficient detail and not in the kind of scientific detail we would expect at A2. Coursework is a valid assessment tool at GCE but it is important that it is robust and capable of discriminating between candidates in the same way as the external examinations at A2 do. It is essential therefore, that errors such as lack of precision in measuring graphs or a failure to fully justify the choice of statistical analysis (in a way that is commensurate with A2 standards) are penalised.

A1 **Develop a Hypothesis**

The standard of biological knowledge provided by the candidates is generally of a very high standard, however, there are often large amounts of irrelevant information provided. The discussion should link directly to the development of the hypothesis

tying in the relevant background knowledge, specific to the problem presented and using scientific terminology that would be deemed to be of an 'A2 standard'.

A2 Plan a Procedure

Many plans and methods are written in the past tense thus suggesting they are written after the practical has been completed. It is essential the planning sections (A1, A2 & A3) should be written prior to the practical being carried out and the range chosen by the candidate should be their own. If results need to be pooled then a standard practical can be given to the candidates after they have completed their plan.

A3 Planning for Analysis

Pupils should choose their own statistical test for analysis based on their choice of independent variable being investigated. This can be changed when the common procedure is issued. The main concern for the moderation tram was the lack of appropriate justification of the statistical test being chosen as outlined in the marking criteria in the specification. This should link to the type of data that is being recorded and the range of the I.V. e.g. confidence limits would be used for a range of continuous data.

B1–B2 Recording & Communicating

Many problems that exist here have been mentioned in the AS report. The table of results should be the candidates own results and should include the raw data being collected.

C1 Analysis

This continues to be well carried out by the pupils, however, there are still issues with Null hypotheses and captions on graphs frequently do not mention means or confidence limits.

C2 Interpretation

Most centres have grasped the assessment of reliability however, there is still an issue with some centres where there is no direct reference to the statistics calculated from their own results. A common mistake with regards to the comment on the reliability was the statement "my results are very reliable but this could be improved by further replication".

Whilst in many cases it is appropriate to repeat the biological knowledge given in the development of the hypothesis, there are times when the results found might need a different approach to explain what was found. If, in these cases, this is not attempted then the candidates should be penalised.

C3 Evaluation

As with AS level this section provides the greatest number of discrepancies between teacher and moderator. When appropriate, the candidate should suggest possible changes to the range investigated (this could be manipulated by the range chosen by the teacher). The appropriateness of the measurements has the same problems which are dealt with in the AS report as are the problems with validity.

There were some issues with the outline of another independent variable to be investigated. An attempt at a prediction and a range of the independent variable should be given.

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