Rewarding Learning

CCEA GCE - Biology (Legacy)
Summer Series 2017

Chief Examiner's and Principal Moderator's Report

biology

Foreword

This booklet outlines the performance of candidates in all aspects of CCEA's General Certificate of Education (GCE) in Biology (Legacy) for this series.

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

This booklet 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.

Contents

GCE BIOLOGY

Chief Examiner's Report

Summer 2017 saw the final series of the full suite of units of the legacy specification. Each paper provided candidates with the opportunity to show their knowledge, understanding and skills in 'A' level Biology.

Across the suite of papers, there was little evidence of candidates not attempting all the questions. There were very few large blank spaces in any of the four papers and there was very little evidence of candidates not having enough time to complete their papers. Each paper contained a range of question types, including straightforward recall of content and the testing of important concepts at this level. Furthermore, in each paper, particularly at A2, there was a range of unfamiliar stimulus material testing candidates' ability to analyse and evaluate information.

Each of the papers proved to be effective in discriminating among candidates of different abilities.

AS Assessment Units

General

Each paper had a similar structure to previous papers and candidate performance was broadly similar to that of previous years.

Assessment Unit AS 1 Molecules and Cells

This paper provided good coverage of the specification and proved accessible for a wide range of ability levels. There was evidence that candidates, in general, clearly understood what was expected in answering each question and it also appeared that candidates had sufficient time to complete the paper. The cohort taking this paper was primarily A2 candidates repeating AS1, and this was reflected in a greater level of understanding and depth to responses when compared to typical responses from 'new' AS candidates in questions common across the legacy and revised specifications. The paper contained a variety of stimulus materials, including a photomicrograph, diagrams and tabular results, and as always, candidates coped well with this.

While some questions were reasonably challenging at this level, e.g. Question 5(c)(ii), Question 6 (b)(ii), and Question 6(c), others were very accessible, e.g. Question 1, Question 2 and Question 8(a). Hence the paper proved discriminating across a range of ability levels.

It is particularly encouraging to note that many candidates performed well in several of the questions involving application of knowledge in novel situations, for example, Question 5 and Question 6.

Q1 While this was a relatively straightforward first question with most candidates achieving five marks, it did require candidates to have a detailed knowledge of enzyme structure and functioning. Those who did not achieve full marks often appeared confused with the correct use of key terminology relating to enzyme action, e.g. quaternary in the place of globular or lock and key instead of induced fit.

Q2 Again, a question well answered by most candidates. Part (a) was the least well answered part of this question; many candidates who did understand the difference between saturated and unsaturated bonds did not respond in enough detail regarding the double bond between two carbons. Lacking detail with regard to the formation of a phospholipid in Question 2(b)(ii) was the main reason candidates did not achieve this mark. Parts (c)(i) and (ii) were recall and very well answered by a majority of candidates.

Q3 Part (a) was very well answered, with most candidates being awarded four marks. The clarity and annotation of the photograph provided candidates with a reference point from which they were able to correctly identify the tissue layers. Some candidates lost one mark in Part (b) through lack of biological detail and non-technical language on the function of the muscularis externa. Very few candidates were able to provide a sufficiently detailed response for Part (c) – although the question appeared to be well understood, there seemed to have been difficulty in formulating a suitable response despite this type of question not being novel.

Q4 This question differentiated effectively across the candidature. Part (a) was answered correctly by the majority of candidates; however, an overwhelming majority of candidates were unable to achieve two marks in Part (b). Provided with the information that there were six chromosomes in the diploid cell it was expected that candidates would understand that this would be reduced to three in the second division of meiosis, and that there would be one from each pair. Those who were awarded one mark generally drew three chromosomes of equal size, therefore losing the mark through not making it clear there was one from each pair. Part (c) was the most differentiating section of this question. Those who were able to fully explain the consequences for the genetic conformation of the chromatids or the combination of chromosomes in the gametes of independent assortment and crossing over in sufficient detail were able to access all of the marks, whereas those who could not generally achieved two marks for stating the processes. This demonstrates the need for candidates at this level to have a sound understanding and to be able to convey that understanding with clarity. Part (d) was well answered by many of the candidates.

Q5 This question was accessible with candidates of all abilities gaining at least some marks. Part (a) was generally well answered although a minority of candidates were not able to recall that chlorophyll contains magnesium. Part (b) resulted in many responses of parallel chains resulting in the high tensile strength of cell walls, but neglected to provide the detail of the composition of cellulose which results in the chains and fibrils of the cell wall. In Part (c) a majority of candidates were able to understand that the virus could pass through the plasmodesmata, but only the more able candidates were able to explain the probable effect of a large structure on the arrangement of the grana and the subsequent reduced light absorption. Those who lost marks did so through non-specific responses in relation to the reduction of photosynthesis. Part (d) discriminated between candidates, many of whom did not take the term 'structure' from the stem or were unsure what they were being asked, as many responded with 'membrane-bound organelles' or references to the stroma and matrix.

Q6 Although this was an accessible question where most candidates were awarded some marks, it also discriminated effectively between different ability levels. A significant majority of candidates could define and explain osmosis, and using the stimulus of the question stem, explain the effect of V. cholerae and Dioralyte on the osmotic balance of the cells lining the ileum. Most candidates were able to use the correct terminology of water potential to describe the movement of water from an area of less negative water potential to that of a more negative water potential. However, many attempted to describe the associated change in solute potential and contradicted previous statements or provided incorrect statements in relation to water movement. This resulted in many losing marks. Only the most able candidates were able to use all the information provided in the stem of this question to relate the changes in the osmotic balance due to non-functioning CFTR in the respiratory system (Part (c)).

Q7 This question assessed the ability of students to plan an investigation, present findings and identify trends. Part (a) was well answered by a significant majority of candidates, many achieving full marks or at least three of the four. Candidates were aware of the need for gloves or not to handle the chromatography paper and that pencil should be

used. Less often, candidates could explain that the origin line should be above the solvent or that there should be enough distance between the amino acids on the origin line. There was sufficient evidence to suggest that many candidates had actually carried out this investigation as part of their course. Part (b)(i) was rarely incorrect, but generally Part (b)(ii) was not well answered. Many of the responses were variations on a theme of human error. A minority of candidates were able to determine the role of the solvent in the change of Rf value. The majority of candidates were able to identify that the lack of taurine in the chromatogram was evidence for the risk of developing epilepsy. Part (c)(i) assessed graph drawing skills. This is a recurrent question type; however, some candidates are still not able to use the information provided to draw the appropriate graph - which was provided in the question stem. Many candidates did not draw a scatter graph, opting for a bar graph instead. Many were able to provide a suitable caption and appropriate scaling for the graph with units and labelling. In Part (c)(ii) the majority of candidates were able to identify the trend but a very small minority were able to associate this with the solubility of the amino acid in the solvent.

Q8 **(a)** The continuous prose QWC question had parts that were accessible to all candidates, with a minority achieving full marks. Mainly the marks pertaining to the process of PCR were awarded, as were those in relation to the use of probes and electrophoresis. Some candidates could explain the need for thermostable polymerase in the catalysis of double helices. Marking points referring to the process between PCR and electrophoresis were less often seen. Although some candidates did relate the amplification of DNA and the separation of MRS/RFLP's created by the same restriction endonuclease to be able to compare the DNA of two individuals, many were unable to achieve this essential point.

(b) As with many questions of this type, candidates have difficulty placing validity and reliability into context. One or two marks were most commonly awarded, with prevention of contamination being the most common response. The more able candidates were able to qualify that with examples and consequences. Reliability was less often awarded. 'Repeat the test' is not a sufficient response at this level.

Assessment Unit AS 2 Organisms and Biodiversity

There was a wide range of marks awarded to candidates in this paper. Some obtained high marks displaying a sound grasp of the subject content and well-developed skills in application. Other questions in the paper enabled less able candidates to show their knowledge. Comments on individual questions and responses appear below.

Many candidates lost marks due to their inability to express and communicate their biological knowledge clearly and unambiguously, and there was evidence that some candidates did not read the questions carefully enough.

There was a range of stimulus material for candidates to interpret including photographs, diagrams, graphs and tables.

Q1 This question on classification was well answered by a majority of candidates. This style of question was novel for testing this topic but it proved accessible to most students. Credit was given to those candidates who were unable to spell protoctista or prokaryotae accurately, but who could produce an answer that was broadly phonetically correct. Kingdom prokaryotae was incorrectly named monera or bacteria by a surprisingly high number of candidates.

Q2 This question on biodiversity resulted in a wide spread of marks across the candidature. A small minority of candidates obtained full marks. In Part (a) candidates were asked to identify the chemical used to kill weeds and then use the graph to describe and explain its effects on biodiversity. In Part (a)(i) most candidates correctly identified the chemical as

a herbicide. However, a minority incorrectly answered pesticide. In Part (a)(ii) a majority of candidates received two marks in the description section by correctly identifying the trend and linking this to a reduction in biodiversity. The last two marks were for the explanation and only a minority of candidates obtained both these marks. A lack of detail in the responses resulted in candidates losing one or both the explanation marks. Surprisingly, a significant number of candidates still equate large Simpson's index to high biodiversity! Part (b) was a familiar question on promoting biodiversity through correctly managing hedgerows by regulating their cutting. Many candidates achieved full marks in this section. However, a number of candidates lost marks through not reading the question and supporting information carefully enough and then providing an answer that failed to answer the question as it was asked.

Q3 This question on Fick's law also proved to be discriminating. Part (a) asked candidates to apply their knowledge of Fick's law in relation to the mammalian respiratory system. Part (a)(i) was not well done as many candidates simply stated ventilation and close blood supply without describing how they maintained a high diffusion gradient. This is another example of candidates' failure to read the question stem carefully and answering the question exactly as asked. Part (a)(ii) was usually well answered with many candidates correctly identifying squamous cells. Many candidates are still giving one cell thick as an answer despite this being a frequently asked question in AS 2. Part (a)(iii) was often well answered with candidates correctly identifying large surface area as the remaining factor and that numerous/lobed alveoli were responsible for this in the lungs. Unusual incorrect references to folded alveoli were seen in the responses from candidates from a small number of centres. In Part (b) candidates were presented with the novel situation of considering Fick's law in relation to premature babies. Despite this unusual context, many candidates got both marks and the majority were able to at least identify the factor being affected.

Q4 This question on the Audus apparatus and scientific procedure was generally well answered. Part (a) assessed candidates' knowledge of the apparatus and their knowledge of variables that would apply to carrying out an investigation using this apparatus. Many candidates picked up at least two of the marks available out of four in this section. A minority still struggle with independent and controlled variables. In Part (a)(iii) many gave temperature as the controlled variable but suggested using a standard water bath which would not be appropriate for this experiment. In Part (b)(i) the calculation was straightforward and many achieved full marks. In Part (b)(ii) there were varied incorrect answers including plants needing oxygen for photosynthesis, which displayed a surprising lack of understanding. It was encouraging to see candidates answer Part (c) well – a question on accuracy which in the past many students confused with reliability. Most students accessed this mark, with the small number who didn't referencing reliability or stating another controlled variable.

Q5 The practical skill of drawing a block diagram of a root section was assessed in Part (a); in Part (b) knowledge and understanding of water transport in plants was required and Part (c) required knowledge of the white blood cells in the mammalian circulatory system. The photograph of the root section was very clear and the block diagrams produced by candidates were generally of a high standard. It seems that previous feedback on block diagrams has been incorporated into the teaching of this skill area with a majority of candidates obtaining at least four of the five marks available. In Part (b) a description of the cohesion tension theory was required and this question was worth three marks.

Most candidates accessed two marks through describing the attraction of water molecules to each other and the creation of a pull upwards. Surprisingly, very few candidates described the evaporation from the spongy mesophyll as the driving force for this process. Candidates are still incorrectly referring to evaporation through the stomata. Section (c) covered a small part of the mammalian circulatory system – specifically

the white blood cells. This section proved to be challenging with many candidates only getting one out of a possible three marks. The lymphocyte was most correctly answered but many candidates lost a mark for failure to distinguish between micro and macrophages. These candidates did access a second mark for reference to phagocytosis by either the polymorph or the monocyte.

Q6 This question tested candidates' understanding of classification and directional selection. Part (a) focused on binomial nomenclature and the definition of a species, Part (b) then asked candidates to use information in the question stem and graph along with their knowledge to assess a sampling method and describe the changes in light peppered moths as a result of directional selection. Part (c) asked candidates to identify a key adaptation in the caterpillar of the peppered moth. Part (a) was usually well done with most candidates having a good understanding of the definition of a species. In Part (b)(i), even though the answer could be found in the stem, many candidates gave very general answers and so lost marks. This is another example of where candidates must take sufficient time to read the information given in the stem of a question to help them find the correct answer. In Part (ii), a surprising number of candidates described both the dark and light moths change in numbers. This would have taken valuable time during the examination and many detailed the changes in the dark form with only a cursory reference to the light form and so lost a number of marks. The answers in this section often lacked sufficient detail to access the marks. For example, candidates would state that the pollution reduced and so the trees were lighter but they needed to state smoke or soot pollution to get the mark and this level of detail was stated clearly in the graph. Many candidates added that the light form was better adapted but failed to suggest why and so lost the third marking point. Candidates were not penalised for the use of genes in place of the more correct alleles for the fourth mark. In Part (c), a majority of candidates successfully identified the adaptation of the caterpillar from the diagram provided.

Q7 This question on the heart and the cardiac cycle was generally well answered. Part (a) focused on structures of the heart and how they related to blood flow through the heart. Part (a)(i) was well answered by most candidates, although the identification of chordae tendinae is still an issue with some as the term heart strings appeared in answers. Part (a)(ii) was also well answered though lack of detail on the explanation of the A-V valves cost some candidates the mark. Candidates tended to only give the GCSE level answer of preventing backflow with no reference to ventricular systole. In Part (iii) most candidates only accessed one mark, again due to lack of detail in their answers; to be credited with both marks, candidates needed to include both the pressure and distance differences in these two chambers. Part (iv) was particularly poorly answered with many candidates failing to reference the pressure in both the artery and the ventricle. There were many lost marks due to students referencing atrial instead of aortic/arterial pressure. Part (b) asked candidates to explain the electrical control of the cardiac cycle. Lack of sufficient detail again cost marks in this question. In Part (b)(i) the location of the SAN within the right atrium wall was essential for the mark. Part (ii) was relatively straightforward and, in general, was well done with most candidates accessing three or four marks. Weaker candidates still managed to access some of the marking points with very few responses achieving no marks in this section. Part (c) provided some discrimination as students needed to look carefully at the ECGs provided and give an answer with sufficient detail to access the mark. Candidates who lost this mark either failed to link the missed heart beat to a reduced oxygen supply or referenced an irregular heart beat which was incorrect in this context.

Q8 Section B (the essay) proved to be very straightforward allowing students of all abilities to access marks. Many candidates scored maximum marks, producing outstanding accounts showing excellent understanding of all that was asked. In Part (a) a significant number of candidates obtained all four marks; this type of sampling has been frequently

tested and it is pleasing to see that candidates (and their teachers) have taken feedback onboard from previous questions. Candidates who failed to achieve full marks in this section often failed to recognise this as transect sampling but even these students could obtain at least half the available marks with correct referencing to use of quadrats. Part (b) required candidates to describe and explain environmental factors that influence the rate of transpiration in a plant and to suggest two hydrophytic adaptations for *A. arenaria*. This was very well answered by a majority of candidates. The most frequent loss of marks was the lack of direction when describing the environmental condition. For example, temperature or light would be cited as increasing transpiration, when it should be increasing temperature/light. A small number of candidates still seem to think that water enters the stomata when humidity is high so transpiration increases. Another misconception is that in high light intensities transpiration is lower as water is used for photosynthesis. A majority of candidates were able to identify two xerophytic leaf adaptations. However, a significant number of candidates referenced root adaptations indicating again a failure to thoroughly read the question.

Principal Moderator's Report

Assessment Unit AS 3 Assessment of Practical Skills in AS Biology

The quality of work submitted by the candidates was of a high standard and the presentation of the work by the centres in terms of annotation greatly aided the moderation process.

Marking was generally consistent and adhered closely to the marking criteria. The expectations which have been set by the moderation team at agreement trials and in previous moderator reports have clearly been taken on-board by the majority of centres.

Although the investigations chosen were from a limited range of topics, mainly factors affecting the action of trypsin on jelly, determination of water potential and membrane permeability of membranes, these practicals were well understood by the candidates and this was evident in their reports both in their interpretation and evaluation.

The quality of table construction has improved although in a few cases the captions were limited. Graphical presentations were good, however there were a few issues with scales and lines of best fit, particularly in the determination of the water potential of plant tissue. These lines were sometimes drawn from first point to the last point without really bisecting an even spread of the plots.

The biological knowledge and understanding of the concepts within each practical were of a high standard and pupils have developed a better understanding of reliability and validity issues. These are areas of improvement which have pleased the moderation team.

Chief Examiner's Report

Assessment Units A2

General

Each of the two papers contained a variety of questions assessing the different skills which are developed over the course of studying biology at this level. As in previous series, there is evidence that many candidates continue to develop these skills to a high level, so that achieving success at A2 attests to a candidate's ability to apply his/her knowledge in unfamiliar situations and to bring together knowledge and understanding of several topics in order to explain biological processes.

A significant distinction between AS and A2 is the requirement to think more deeply about biology in order to answer questions on A2 papers. It is encouraging to note that many candidates are able to write excellent answers to the more challenging questions, including those which contain novel content. Analysis of candidate performance clearly shows that while a majority of candidates perform well in those questions testing recall and understanding, only the more able candidates perform well in those questions testing analytical and evaluative skills, particularly if the questions are set in an unfamiliar context.

Assessment Unit A2 1 Physiology and Ecosystems

Candidates taking this unit obtained a range of marks. Some obtained high marks displaying a sound grasp of the subject content and well-developed skills in application. Many question parts provided an opportunity for less able candidates to exhibit the extent of their knowledge and although some questions proved to be challenging, none were beyond the ability of the candidature. Overall, there were very few scripts with a significant number of blank spaces and in most questions candidates attempted response. Most centres had clearly prepared their candidates to a good standard and there was evidence that the content of the specification had been well taught in general. However, there was some evidence that candidates were less well-equipped to do well in those questions involving a practical component. Another issue involved the candidates' mathematical skills, whilst able to calculate part of the answer many candidates then lost marks in unit change. Once again, many candidates lost marks due to their inability to express and communicate their biological knowledge clearly and unambiguously and there was evidence that some candidates did not read the questions carefully enough. Candidates either failed to address the question entirely or only gave partial answers thereby preventing them from accessing all the available marks. In particular, candidates' ability to describe trends was weak; candidates should be reminded that cause and effect are important when describing trends.

Q1 This question was relatively straightforward, requiring recall of key concepts in population dynamics. The complexity of the question was increased by requiring some application of biological knowledge. Many candidates achieved full marks in this question. In Part (b) a minority of candidates lost marks due to not reading the question and not identifying factors directly related to decrease in the number of births. It was pleasing to note that most candidates answered Part (c) correctly.

Q2 Many candidates could correctly identify the ion required for muscle contraction and further elucidate its role in the process of contraction. Part (b) was somewhat novel as a calculation and many of the candidates completed the first step correctly. However, many then further lost marks through misapplication of unit conversion. It should be reinforced that unit conversions are likely to appear in questions and therefore it is important that candidates are aware of these and apply them correctly. Candidates should also be encouraged to consider the sense of their answer upon calculation. For example, myofibrils are not 80 km long (as one candidate suggested)!

Q3 The context of this question, photoperiodism, is familiar to candidates and the question provided a range of marks. In Part (a)(i) a significant number of candidates failed to pick up any marks due to getting two sections wrong. This indicates a general lack of understanding of the process of photoperiodism. In Part (ii) some candidates lost marks by not following the instructions in the stem of the question and instead described regime five instead of regime four. Many candidates clearly do not understand the physiological activity of P_{730} and its importance in the process of flowering. Part (b) was set in a novel context testing the candidate's knowledge of the production and activity of auxin. Many candidates were successful in identifying the idea that auxin concentration in the non-contact surface was much higher than that in the contact surface. However, a smaller proportion linked this to the differential elongation of cells in the non-contact surface relative to the cells in the contact surface.

Q4 This was a relatively straightforward question covering pollution in waterways. In Part (a) a minority of candidates failed to achieve the mark due to inaccurate positioning of the arrow showing the point of pollution. In Part (b) many candidates successfully identified the exponential increase in the bacterial population (although this was expressed in many different ways) and indeed further linked this to the aerobic respiration of the bacteria causing the decrease in oxygen at the site. A minority of candidates linked the organic pollution incorrectly to an algal bloom which is more correctly linked to an inorganic pollution incident. In Part (c) a surprising number of candidates linked this adaptation of *Tubifex* to camouflage for no apparent reason. Candidates were generally successful in obtaining the first mark. The second mark proved more demanding as many candidates did not link the adaptation to its advantage in its particular environment.

Q5 In Part (a) most candidates successfully obtained at least two of the three marks through identifying the processes of the nitrogen cycle accurately. In Part (b)(i) a surprisingly large number of candidates did not identify the kingdom correctly as Prokaryotic and instead answered bacteria or indeed the wrong kingdom Protoctista. Parts (ii) and (iii) of this question were generally very well done by candidates and the soil conditions for the process of nitrification and indeed methods by which the farmer could develop or maintain these conditions on the land were correctly identified. In Part (c)(i) most candidates achieved at least one mark, describing accurately the process of nitrogen fixation; however, some candidates were relatively unclear referring to nitrification rather than nitrogen fixation and further to this the second mark was often not obtained by candidates who were somewhat unclear about the products and the consequential use of the products in the production of plant protein. Answers to this question highlighted poor expression by many candidates when describing biological processes. In Part (c) (ii) prediction of relationship was done relatively well by many candidates. However, a significant proportion still had problems with cause and effect. Part (c)(iii) required candidates to justify the range of nitrate concentrations used in an investigation and this caused significant problems. Candidates tended to meander around the question and a significant proportion could identify the importance of the range in identification of trend. Many candidates then went on to incorrectly discuss reliability as a component of range. Part (c)(iv) was generally completed quite well and most candidates could identify the main trends within the table. Again, a small proportion of candidates had difficulty with cause and effect. Part (c)(v) was generally done well but some candidates struggled to find a second mark.

Q6 This question provided a familiar context for the generation of an action potential; many candidates dealt well with this and explained depolarisation effectively. A significant proportion of candidates in Part (ii) identified the vertical component as hyperpolarisation when it was clearly indicated on the graph that it was the horizontal component that was required therefore leading the candidates to the refractory period as the correct answer. A pleasing proportion of the candidature could provide a suitable answer to explain the importance of the refractory period in this context. Candidates who incorrectly identified the period labelled A were not further penalised and indeed could be awarded the second mark. In Part (b) information was provided to the candidates in a more novel format and candidates were asked to identify the relationships that existed between the components. Many candidates successfully described the relationships that existed, many identifying the requirement to cross the threshold stimulus to generate an action potential or by describing the 'all or nothing' law. However, a significant number of candidates lost marks by not referring to time or frequency when referring to the number of action potentials generated. Many candidates also reversed cause and effect here discussing the number of action potentials producing a particular stimulus strength. In Part (ii) candidates generally identified and explained well the pattern in Section X. Again, candidates had to make reference to the idea of the number of action potentials per unit

time or the frequency of action potentials. It was somewhat disappointing that candidates lost marks in this question by not referencing per unit time or frequency since the term per unit time appeared in the stem of the question. Many candidates could identify suitable controls for this investigation in Part (iii).

Q7 An unfamiliar forest context provided a platform in which to test students' knowledge of succession, environment and population interaction. Parts (a)(i) and (ii) were both done very well by a majority of candidates. In Part (iii) a significant number of candidates misread the question and described and explained the effect of light intensity. Again, candidates lost marks if they failed to use appropriate scientific language. In Part (b)(i) not all candidates could effectively define community in this context. Most candidates in Part (ii) were able to suggest the idea that Haircap moss was outcompeted in the later years by other plant species. However, many failed to succinctly explain the high percentage cover of Haircap moss at the beginning due to it being well adapted to the initial hostile environment following the forest fire. In Part (c) most candidates identified the link between release of seeds and the melting of the glue on the Jack pine cones. Very few candidates obtained the second bullet here, not identifying the clearing of the canopy and large trees allowing a greater amount of light to reach the forest floor. A fair proportion of the candidates did however go on to indicate the reduced competition of other species due to clearing by the fire and allowing the growth of the Jack pine.

Q8 A disappointingly large number of candidates were not able to identify cuboidal epithelial cells. A range of incorrect identifications was provided for a relatively simple recall question. Most candidates were able to obtain two marks in Part (ii), identifying appropriate and correct adaptations of the cells and relating them effectively to function. In general, this was a novel question providing a high degree of stretch and challenge for many of the candidates. Part (b) of the question contained some synoptic elements which proved challenging to many. Poor use of terminology and relatively inaccurate language prevented many candidates from obtaining marks. Parts (i) and (ii) showed a range of marks and proved discriminating. A significant proportion of candidates have difficulty with the concept of solute potential and indeed the fact that an increased amount of solute will decrease the solute potential or cause it to become more negative. Candidates should be reminded that when interpreting data in a table (Part (c)), it is not enough to simply state values directly from the table. To obtain the first mark the candidates needed to indicate there is a relative difference between the protein concentration in the Bowman's capsule of the normal individual and the Goodpasture individual. Most candidates appear to understand the nature of the basement membrane as the effective filter or could describe its activity. Part (c)(ii) was also discriminating. This question required candidates to identify correctly the appropriate immune response. Many candidates seemed to be confused with the nature of the basement membrane assuming it is a cellular structure, although this is not actually the situation. Since it is not a cellular structure this would imply that the main immune response is humoral/antibody mediated. Candidates answering this question part in a cell-mediated context were still able to gain two marks. When discussing the nature of the basement membrane it is recommended that students understand that it is a non-cellular structure. In Part (iii) most candidates successfully identified the activity of the immunosuppressant drug in its prevention of mitosis due to forming cross links with the DNA. This would then lead to a reduction in either B or T cells and therefore the appropriate responses of the cells. It was not enough to answer that the drug would prevent DNA replication as this was clear in the stem.

Q9 Provided a good platform for candidates to discuss their understanding of accommodation, visual acuity and visual sensitivity. Candidates dealt very well with this question and were able to describe accommodation effectively and furthermore could describe the formation of an image of a coloured object. However, a significant

proportion of candidates did confuse the state of the ciliary body and the consequential effect on the suspensory ligaments with the appropriate distance of the object from the eye. Consideration of pupil aperture was inappropriate in Part (a) of the question – as was a discussion of rod cells since they are not involved in colour vision. Most candidates provided a reasonable discussion of visual acuity and sensitivity in Part (b). However, some candidates still clearly confuse the activity of rods and cones and therefore this hampered their discussion of acuity and sensitivity. In general question nine was answered well showing a range of marks and a pleasing number of candidates achieving full marks.

Assessment Unit A2 2 Biochemistry, Genetics and Evolutionary Trends

As is normal with A2 papers, this paper covered all the major topics in this unit. The paper contained a wide range of question types including questions that tested recall and understanding, e.g. Question 1, Question 2(a), Question 3(b), Question 4(a) and Section B (the essay). There were questions that tested the candidates' ability to analyse novel information presented in a variety of forms, e.g. Question 4(b) and parts of Questions 6 and 7. As is normal with A2 2 papers there were question parts requiring calculations and statistics, e.g. parts of Questions 6 and 7.

Q1 The first question this year was on genetically engineered microorganisms (GEMs). While the question was accessible to almost all candidates, very few actually obtained all four marks available. Part (a) asked candidates to state the role of bacteriophages in genetic engineering. A majority of candidates were aware that in this context, bacteriophages are vectors and so achieved the mark; a sizeable number answered by description rather than using the term vector. Part (b) required candidates to state two safety precautions that can be used to prevent GEMs causing harm in the environment. Generally, this was well done. Where marks were lost it was usually because answers lacked detail. Part (c) was on the benefits of using microorganisms (as opposed to plants or animals) in genetic engineering. The most common correct answers were the shorter reproductive cycle of microorganisms (meaning that more transgenic microorganisms could be produced more quickly) or that using microorganisms is ethically more acceptable. A significant minority of candidates misinterpreted the question and made reference to the fact that GEMs would have human genes inserted and therefore could make, for example, human insulin, whereas animals would not!

Q2 Animal classification and digestion in animals were the topics covered in this six-mark question. Most candidates obtained at least some marks, but as with question one, only a minority obtained full marks. Part (a) required candidates to complete a table outlining key features of three animal phyla. Able candidates were able to obtain all three marks but candidates less secure in their knowledge dropped at least some marks. Part (b) tested candidates' understanding of the evolutionary trends in digestion across the animal kingdom. In Part (b)(i) a significant number of candidates gave a definition of extracellular digestion in animals that could equally have been applied to fungi and therefore failed to obtain the mark. In Part (b)(ii) a majority of candidates understood that in platyhelminthes digestion is both extra- and intracellular but in the chordata and annelida it is extracellular only.

Q3 This eight-mark question on protein synthesis proved to be an excellent discriminator. The question contained a number of short-answer questions and also the first extended answer four-mark question on the paper. Part (a)(i) required that candidates interpret two graphs, one showing numbers of the four types of DNA bases and the other numbers of the four types of mRNA bases transcribed from that section of DNA, but without individual bases being identified. Surprisingly, very few candidates could get this correct.

Part (ii) was much more accessible, with most candidates being able to answer that the introns or non-coding bases were removed in the mRNA after modification. Part (b)(i) was also well done with a significant majority of the candidature answering ribosome correctly. Part (b)(ii) discriminated well with only a minority of candidates attaining the four marks. This was surprising as the question was based on a diagram representing translation and of a type that had been asked a number of times before. A significant number of candidates had the misconception that the ribosome was moving to the left. Other marks were often dropped through lack of detail or lack of accuracy.

Q4 Knowledge and understanding of photosynthesis was tested in this question. In Part (a)(i) most candidates were able to answer that ribulose bisphosphate is a 5C compound and that glycerate phosphate is a 3C compound. Part (a)(ii) was usually well done by the more able candidates. While a majority of candidates could answer that ATP provides energy for the reduction of glycerate phosphate to triose phosphate, a much smaller sub-set could answer that ATP donated a phosphate in the formation of ribulose bisphosphate. Part (b) was applied in nature, and as expected, a greater variability was evident in candidate performance. In Part (b)(i) close observation of the diagram showed that the steep reduction in light intensity was at the cuticle (position Z) and not the epidermal layer. A significant number of candidates lost this mark by referring to the upper epidermis reflecting light or that other colours were absorbed but green reflected. Part (ii) proved very discriminating. Candidates who scored well linked both the light intensity and level of carbon fixation to the different layers of the leaf (i.e. epidermis, palisade layer and the spongy mesophyll). A number of candidates seemed to ignore the diagram and described photosynthesis in a leaf. The most common marks awarded were for little or no carbon fixation or photosynthesis taking place in the epidermis due to lack of chloroplasts and most taking place in the palisade layer where chloroplasts were plentiful. The link between light intensity and carbon fixation was much less frequently seen in candidate answers. Part (c)(i) was usually well done indicating that most candidates are familiar with limiting factors graphs. Part (ii) was less well done. Most candidates were able to state that light intensity would be high in the summer, therefore light would not be limiting; however, a significant number mistakenly referred to light duration rather than intensity. However, the most common reason for most candidates failing to get this mark was the omission of reference to high temperatures (as well as high light intensity).

Q5 Question five tested plant reproduction and involved a Hardy-Weinberg calculation. Part (a) provided little difficulty to most candidates, with all bar a small minority answering that cross-fertilisation leads to variation. Part (b)(i) proved to be much more discriminating. This question tested candidates' knowledge of angiosperm reproduction in the stage between pollination and fertilisation. Candidates who had learned this topic did well, but they were in the minority. A majority of students were not secure or patchy in their knowledge and so often obtained only some of the marks available. Part (b)(ii) was more applied and this also proved discriminating. Only a minority of candidates could deduce that germination would be delayed to the end of winter/start of spring and that then the conditions would be much better resulting in a higher chance of survival. A minority of candidates answered in terms of the cold weather providing a 'filtering' mechanism with only those best adapted for harsh weather surviving and passing their genes on. Part (c) tested candidates' ability to carry out a Hardy-Weinberg calculation. This was usually well done although a significant number of candidates incorrectly took the 10% (0.1) to be the proportion of homozygous recessive individuals, rather than alleles, and so ended up with an answer of 43% (rather than the correct 18%). In Part (ii) most candidates could state one condition required for the application of the Hardy-Weinberg equation to apply.

Q6 Question six covered respiration both in theory and in a practical setting. As with most questions in this paper it was an effective discriminator with a broad range of marks being achieved by the candidature. A majority of candidates found Part (a) relatively

straightforward. Most candidates could identify the link reaction from the diagram in Part (a)(i) and a significant majority could state that oxidative phosphorylation takes place in the cristae or inner mitochondrial membrane. In Part (a)(iii) candidates were asked to account for the $6CO_2$ produced during the respiration of one molecule of glucose. Most candidates could answer that the link reaction occurred twice for each molecule of glucose and therefore $2CO_2$ were produced there. A majority were able to deduce that $4CO_2$ were produced in Krebs cycle but a significant minority of candidates weren't able to explain where the 4 came from, with the fact that two molecules of CO_2 are produced for each turn of the cycle being the marking point most often missed. A small number of candidates answered that carbon dioxide was also produced in the electron transport chain. The setting for Part (b) was a practical that could be carried out in the laboratory of any centre and many of the question parts focused on experimental design. Part (b)(i) required candidates to state two variables that should have been controlled. This was generally well done and answers such as volume or concentration of the glucose solutions, size of beads, age or strain of yeast were commonly seen and rewarded. However, 'amount' of glucose failed to gain credit. In Part (b)(ii) most candidates could deduce that if the alginate coating was to stop carbon dioxide escaping it would also stop oxygen entering the beads. Part (b)(iii) was also answered well with candidates able to answer that the beads rose more quickly in the glucose at the higher temperature due to higher rates of respiration producing carbon dioxide more quickly. Parts (b)(iv) and (v) proved more demanding. Only a minority of candidates picked up both marks in Part (iv). Answers such as different thickness of alginate coating, different ages of yeast, different amounts of stored glucose showed good understanding. Answers such as human error and variation in temperature were not rewarded. Genetic variation within the yeast also failed to gain credit as small differences in genome are unlikely to account for the wide variability of the results. Part (v) proved the most demanding part of the entire question for many candidates. The 'default' answer was a bar chart with confidence limits but a number of other options also gained credit. The use of 'range' to show variability did not gain credit as this will only record the value at each extreme and give no indication of the overall variability.

Q7 The genetics of the banded snail (*Cepaea nemoralis*), statistics and natural selection were tested in this nineteen-mark question. Most candidates found Part (a) relatively straightforward and they were able to show how a cross in a multiple allelic situation could produce a 2 : 1 : 1 ratio. The mark most frequently lost was the failure to link genotypes and phenotypes. Part (b) required candidates to calculate a Chi square value from the data from a genetics cross. This was generally well done although a small minority of candidates failed to get the correct value through failing to cancel the negative value when squaring the difference between the observed and expected value for the brown snails. Part (b) was frequently well done and most candidates could appreciate that for this particular cross there were two degrees of freedom and that the probability value was $0.5 > p > 0.1$. Part (b)(iii) proved more discriminating with a significant number of candidates stating that the result was significant or that it agreed with the null hypothesis (when there was no null hypothesis in the question). Part (c) was a five-mark dihybrid cross that was well answered by a majority of candidates. A small number of the weaker students couldn't work out the gametes and so lost all five marks. While many candidates did obtain the five marks, a significant minority of those who could set out the dihybrid cross in the correct format then lost marks for treating banding in the snails as dominant (when it should have been recessive), and/or not linking phenotypes with genotypes and/or not linking the ratio to the correct phenotypes. Part (d) tested candidates' ability to link their understanding of selection to the distribution of the snails across Europe. In Part (d)(i) a majority of candidates obtained three of the four marks available. These candidates were usually able to describe the trend in the scatter graph and explain why brown snails were selected against in hotter regions and selected for in cooler areas.

Only a minority of candidates went on to link this to directional selection. Many candidates obtained one mark in Part (d)(ii) for appreciating that the carbon dioxide increase resulted in global warming. Fewer were able to add that this would lead to a further reduction of brown snails in the hotter regions or an increase in the cooler areas. Answers that just referred to brown snail numbers decreasing failed to gain credit.

Q8 Section B produced a full range of responses from the candidates. A small minority of very able candidates achieved full marks. Full marks were much more common in the short Section (b) that asked candidates to describe the methods available for obtaining a desired gene, than in the longer Section (a) that tested genome sequencing. Even many able candidates struggled to decide what Part (a) should actually contain and there is little doubt that methods of obtaining genes in genetic engineering and transferring these genes into other organisms is much better known and understood by candidates than the more recent technology of gene sequencing. Nonetheless, genome sequencing is clearly identified in the specification and linked to this in the specification is a sizeable range of benefits that genome sequencing is bringing and can bring, particularly in the wider medical field. This section in the specification formed the basis of the mark scheme used. Many candidates confused gene sequencing with gene mapping, i.e. identifying particular genes, and provided information on genetic engineering in its various forms such as GM crops. Part (b) was very well done by a majority of candidates. Terms such as restriction endonucleases, recognition sequences, reverse transcriptase are well known and understood by the candidature and so a significant number of candidates were able to obtain full marks in Part (b).

Principal Moderator's Report

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

The quality of work submitted by the candidates was of a high standard and it was obvious the candidates were well prepared for their coursework tasks. Generally, application of the marking criteria by teachers was in agreement with the standard expected by the moderation team. Presentation of the coursework was as requested and those centres that provided a mark scheme or where annotation was clear, this greatly aided the moderation process. The majority of the investigations centred around membrane permeability, factors affecting enzymes or population growth. There were some fine examples of ecological investigations although it appeared that many of the plans for these were completed after the fieldwork. It would have been preferable that an investigation be planned before the fieldwork and then it can be amended after the trip. Plans should not be written in the past tense!

A1 Development of the hypothesis

This section has been much improved and the standard of the background knowledge was generally what is expected at A2 level. There were some cases were the prediction did not include units/measurements linked to the hypothesis.

A2 Planning a procedure

There were still too many examples were the range of the chosen independent variable were exactly the same throughout a centre. Pupils are to think of their own range and justify why they have chosen this. Candidates fully embraced the justification of the controlled variables, however there were still some centres were a GCSE sentence that only one variable can be changed at a time was awarded incorrectly a mark.

A3 Planning Analysis

This has improved over the past two years and most centres have taken on board what the moderation team expects for each of the criteria. There are still some centres which don't give a full explanation as to the reasoning behind their choice of statistic. Confidence limits are not used just to assess reliability.

B2 Recording the data

Tables were well presented and there were very few cases of pupils not providing a table of their own results.

There were some issues with captions especially when a colorimeter was used to record results. Temperature does not affect the transmission of light.

C1 Statistical & Graphical analysis

The statistics were well calculated by the candidates and for the t-test correct identification of p values and decisions regarding the Null hypothesis were evident. There were some issues with plotting of confidence limits which were not penalised by teachers. If the confidence limits are asymmetrical then there is an issue with the plotting or with the calculation of the confidence limits.

C2 Interpretation

The assessment of reliability has improved and candidates showed a real appreciation of the statistics calculated and their link to significance and reliability. There were some occasions were the need for further replication or not was not addressed and this should have been penalised.

C3 Evaluation

It is good to see the candidates show an appreciation of the procedure and apparatus used and also factors which could affect validity. This section in the past would have been the area were there was most differentiation in marks within a centre and between centres. The standard of responses for each of the criteria has improved.

The overall quality of work submitted by centres has improved over the duration of this coursework and this has pleased the moderation team. It was obvious the centres which have attended agreement trials and have read the previous moderator reports as the work they submitted closely matched the expectations of the senior moderation team.

Contact details

The following information provides contact details for key staff members:

- Specification Support Officer: Nuala Tierney
  (telephone: (028) 9026 1200, extension: 2292, email: ntierney@ccea.org.uk)
- Officer with Subject Responsibility: Edith Finlay
  (telephone: (028) 9026 1200, extension: 2267, email: efinlay@ccea.org.uk)