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CCEA GCE - Biology
(January Series) 2014

Chief Examiner's Report

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Foreword

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

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GCE BIOLOGY

Chief Examiner's Report

Numbers taking GCE Biology in January 2014 were significantly reduced as a consequence of current assessment regulations. The two AS papers were catering for re-sit candidates only. While this has been the situation for January AS2 papers in the past, this is the first time that Year 13 students were not sitting the AS1 paper in January. There was also a small drop in the number of candidates taking A21 at this time.

In the light of this change, it was pleasing to see that the majority of candidates were well prepared for the AS papers and that performance levels were often very good.

In later sections of this report, individual papers will be reviewed in detail. In this introductory section, features common across the suite of papers will be outlined in an attempt to encourage centres and their candidates to improve further on the standard set.

In general, there was little evidence of candidates not attempting all the questions. There were very few large blank spaces in any of the three papers. Furthermore, there was very little evidence of candidates not having enough time to complete their papers.

Many candidates lost marks by not reading the question carefully. Examples of this will be highlighted in the reports for individual papers. However, it is important to note that this was a significant factor in marks being (unnecessarily) lost across the suite of papers.

There is a requirement for a number of questions to be applied in nature, often involving unfamiliar content, in each of the papers. There is clear evidence that many of the weaker candidates found this type of question challenging. However, it is very pleasing to note that many candidates performed extremely well in these questions in this series. This was evident across the range of papers.

As with recent series, the presence of an 'extra lined page' at the back of each paper provides candidates with extra space to complete answers should they run out of space in the main body of the booklet. Many candidates use this page very effectively and appropriately cross-reference their answers ensuring that examiners are fully aware which question part the extra information refers to. Additionally, most candidates very helpfully note at the end of the question part concerned in the main body of the paper that the question is continued on the extra lined page.

The main purpose of adding the extra lined page is to reduce the use of supplementary answer booklets. There is some evidence that this is working but it is clear that many candidates unnecessarily use supplementary booklets (often leaving the extra lined page untouched). Additionally, the supplementary answer booklets are often unattached in any way and consequently at risk of becoming separated from the main body of the completed question paper. It is also evident that the use of the extra lined page and/or supplementary booklet is centre dependent, i.e. in many centres all the candidates will appropriately use the extra lined page and usually do not need to use a supplementary booklet, whereas many of the candidates in other centres ignore the extra lined page and resort to the supplementary booklet at the first opportunity. It is strongly recommended that centres make all concerned, e.g. their candidates and invigilators, aware of the extra lined page and the benefits of it as opposed to the supplementary booklet.

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Assessment Units AS General Comments

Each of the two AS papers were effective in discriminating among the candidature. Each paper had a broadly similar structure to previous papers. In each, there were questions assessing knowledge and understanding, key biological skills (e.g. a table in AS1 and a graph in AS2), practical techniques and the analysis of data. In each paper there was evidence to suggest that many candidates struggled in particular with those questions involving biological information or practical investigations set in an unfamiliar context.

Marks were often lost through not answering the specific question that was asked or providing answers that lacked the appropriate level of detail required. These issues will be raised again in the following sections.

Assessment Unit AS 1 Molecules and Cells

This paper generated a wide range of results and successfully discriminated among candidates of differing abilities. The candidature for this paper was unusual in that it was composed entirely of re-sit candidates. While this may have led to an expectation that the standard would be higher than in previous exam series, it was clear that some candidates had prepared much more effectively than others for the paper. On the whole, it was a suitably demanding paper, with opportunities for all to achieve marks in line with their ability. It contained a wide range of stimulus material, including graphs, diagrams and a photomicrograph, as well as a chromatogram and a genetic fingerprint. In addition, a significant amount of reading was required in order to answer several questions (for example, Question 5, Question 6(c) and Question 7), and it is pleasing to note that many candidates coped well with this. This may be in part due to their prior experience of examination materials, their familiarity with more advanced A2 content, or simply their increasing maturity.

As always, however, there were some question parts which proved very challenging across the candidature (for example, Question 7(b)(vi)). In addition, the perennial problem of misreading the question and/or using incorrect or vague terminology caused many candidates to lose marks. As remarked upon in previous series, the practical skill of presenting results, as assessed in Question 7(b)(iii), remains poorly developed in a majority of candidates.

There was no evidence that candidates were short of time in this examination and there were no questions which were left unattempted by any significant number of candidates.

Q1 This question concerning the nature of DNA was a straightforward introductory question, allowing a majority of candidates to achieve at least three out of the five marks available. Very few, however, achieved the full five marks. The most commonly missed answer was 'anti-parallel'; some candidates failed to identify the 'histone' proteins in the last line too.

Q2 This question was generally well attempted, and it was evident that many candidates had experience of carrying out chromatography, as opposed to simply reading about it or seeing a demonstration.

(a) While many candidates answered this well, some described procedures for developing the chromatogram, rather than setting it up, as the question asked. For those who did approach the question appropriately, it was pleasing to see a wide range of correct responses, as detailed in the mark scheme.

(b) This question part was generally well done. The most common faults included inaccurate measurements, measurements taken from the wrong positions and

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adding units to the final answer. On the whole, though, most candidates achieved the two marks available.

(c) Answering this question part correctly involved synthesis of the information presented in Parts (b) and (c), and many candidates managed this well, demonstrating a sound ability to interpret chromatograms of this type. Some failed to note that monosaccharides had been added to Lanes 1 & 2, while disaccharides were added to Lanes 3 & 4 (as mentioned in the stem to Part (c)) and thus were unclear about which sugar was where. A minority responded with mono- or disaccharides which were not mentioned anywhere else in the question (for example, lactose).

(d) This question part was answered correctly by a significant proportion of candidates. Common incorrect answers included amylose/amylopectin (despite the reference to a monosaccharide in the question stem).

Q3 It is pleasing to note that this question on the processes of nuclear and cell division in animal and plant cells was very well answered indeed, with a majority of candidates losing only one or two marks at most.

(a) A majority correctly identified the stages shown in the photograph and placed them in the correct sequence (Parts (a)(i) and (iii)). The part which presented the most difficulty was Part (a)(ii); where some candidates failed to correctly distinguish between chromosomes and chromatids, and others simply did not give a full enough response to achieve the three marks available.

(b) This was generally well answered, despite a range of incorrect spellings of 'cytokinesis'.

Q4 This question proved quite discriminating, with a range of marks being awarded. While many candidates answered Part (a) well, Part (b) involving a novel example of the effect of temperature on enzyme activity proved more discriminating.

(a) It was encouraging to note that candidates were responding more successfully than in previous series to the instruction to 'Describe the trends...', and were ensuring that they focused on the description of the observed trends, rather than an explanation. While this comment does not apply universally, it is nevertheless a pleasing development. There remains however a tendency in many candidates to describe a dependent variable as increasing or decreasing 'rapidly' with increasing independent variable, in cases where that independent variable is not time. Candidates will continue to be penalised for this error. In this case, the correct description of the trend for temperatures above 25°C was that the enzyme activity decreases dramatically or sharply. Part (ii) was generally well answered, with the most commonly missed mark being the required reference to the disruption of named bonds in the protein at higher temperatures.

(b) Few candidates achieved the two marks available for this question part, for a variety of reasons. Many concentrated on the difference in the assumed *optimum* temperature for each enzyme, despite the reference in the question stem to the fact that they had different temperature *ranges*. Others suggested an appropriate reason for the difference in temperature ranges, but then failed to articulate how this would be an advantage to the growth of the soybean plant. Still others focussed their responses on the temperature range of mammalian lipase, rather than that of soybean lipase. This demonstrates a

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relatively common weakness among candidates: a difficulty in concentrating on the requirements of the question, without including extraneous details.

Q5 This question proved to be very discriminating, with candidates achieving the full range of available marks. While many candidates had developed the skill of interpreting genetic profiles to draw conclusions, only a minority were able to articulate their interpretation effectively. Fewer still were competent at evaluating different sources of evidence, as required in Part (c).

(a) This part was reasonably well answered, with a majority of candidates correctly identifying the enzymes named as restriction enzymes. Part (a)(ii) proved more challenging, but still many candidates achieved at least one of the two marks available. Some erroneously discussed the induced fit hypothesis or considered that the two enzymes would somehow compete for access to the DNA. This question did involve bringing together concepts from two separate topics: DNA technology and enzymes; and the responses given indicated that there exists a range of levels of ability with respect to this particular skill.

(b) As mentioned, candidates were competent at drawing conclusions (of paternity) from genetic profiles; however a significant proportion seemed to struggle to articulate a justification of their conclusions. For this reason, many candidates achieved only one of the two marks available here, through correctly concluding that the show dog was not the puppy's father. As can be seen from the mark scheme, the justification for this conclusion was not simply that the puppy has few bands in common with the show dog. Rather, it was that those bands which the puppy does not have in common with the mother were also missing from the show dog's genetic profile. A related error was the assertion that the puppy should have half of the bands in its genetic profile from the mother and half from the father. Furthermore, some candidates lost marks here through referring to the 'genes' on the profile, rather than the bands.

(c) This part also proved challenging, with a significant number of candidates simply repeating and elaborating upon their response to Part (b). Others referred to the 'accuracy' and/or 'reliability' of the evidence, demonstrating an inadequate understanding of the distinction between these terms and 'validity'. However, some candidates had read and understood the question correctly and each of the alternative points in the mark scheme was given by at least some candidates.

(d) This was generally well-answered, with a minority of candidates failing to specify that the enzymes would cut viral DNA, rather than just DNA in general.

Q6 This question was reasonably straightforward, with only Parts (a) and (c)(iii) posing more of a challenge to a significant proportion of the candidature. Some candidates had difficulty defining the term 'organic macromolecule', writing rather vague responses for the 'organic' component in particular. Part (c) was set in a novel context and as such would be expected to discriminate between candidates of differing abilities. Again, the problem for many lay with misreading the question and assuming that a diagnosis of coeliac disease had already been made. Hence responses such as 'to see which parts of the ileum are damaged' and 'to see if the whole ileum is affected' were relatively common.

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Q7 This question again discriminated effectively between those of differing abilities, assessing as it did a variety of skills. Set in the context of a novel experimental procedure, candidates generally coped well in understanding the aims and results of the experiment. However, they coped less well when it came to demonstrating skills associated with investigations, such as explaining the rationale behind steps in the procedure (Part (b)(ii)), displaying experimental data in a table (Part (b)(iii)), and using their biological knowledge of organelle function to explain the data obtained (Parts (b), (v) and (vi)).

(a) This part was generally well answered.

(b) In Part (i) many candidates correctly explained the role of the buffer in preventing osmosis; a smaller number also described its role in maintaining a constant pH. Part (ii) elicited some rather vague answers, including references to a fair test, which are considered insufficient at this level.

Responses to Question Part (b)(iii) were, on the whole, disappointing. Very few candidates achieved the full four marks available, which, considering the scores achieved in the coursework component of the AS qualification, demonstrated a significant discrepancy in the assessment of the skill of tabulating results correctly. Very few candidates included information in their column headings about which of the tubes, A or B, contained cyanide. In addition, many failed to observe the convention for a caption, i.e. inclusion of the dependent variable, independent variable and biological material.

Part (b)(iv) was very well answered on the whole, but Parts (v) and (vi) were correctly answered by only a very small minority of candidates. As the final question parts in Section A, it is appropriate that these were some of the most challenging questions on the paper, requiring significant skills of synthesis and application of knowledge.

Q8 In this Section B question, candidates were tested on their knowledge and understanding of some of the mechanisms of transport across a cell membrane. While this topic has appeared in this section in previous series, this question asked candidates to organise their knowledge and understanding in a different way. In Part (a), they were required to describe the similarities and differences between three methods of transport across the membrane and, in Part (b), to explain why different methods are necessary.

(a) Candidates generally gave better responses to Part (a) than to Part (b), and many gave detailed and well organised responses to this question Part. A majority of candidates were able to discuss effectively the three methods of transport in terms of their active or passive nature and the involvement of proteins. Fewer were able to discuss the roles of the proteins in detail, as required for the later marking points in the mark scheme.

(b) This alternative way of discussing the three methods of transport proved more challenging to candidates, and few achieved high marks in this question part. One issue appears to be that candidates found it difficult to organise their knowledge of this topic in a way that would answer the question effectively, and often seemed to be attempting to answer a more straightforward question. In addition, while a significant proportion were able to explain why the different methods were necessary, in terms of e.g. size/polarity, fewer went on to explain how this conferred selectivity on the membrane.

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The quality of written communication (QWC) in this question was generally good and most candidates were able to organise their response in a coherent sequence, particularly in Part (a).

Assessment Unit AS 2 Organisms and Biodiversity

There was a wide range of marks obtained by the candidature in this paper, with a good degree of discrimination possible due to the type of questions set and the areas of the specification examined. As has been the case in the past, this cohort of candidates primarily consisted of those who were taking the paper as a re-sit option and there was evidence of good examination technique in terms of time management and a mature approach to the essay question. Centres and candidates are to be commended on this.

As noted below, questions testing Assessment Objective 3 (AO3) proved to be quite demanding, and given the level of practice and its prominence in coursework a surprisingly large number of candidates failed to obtain full marks in the graph drawing exercise.

Throughout the questions set, there was no single sub-part which proved beyond the capability of the totality of the candidates and the performance in this paper was highly comparable to those in previous series.

Q1 This initial question proved to be very accessible to most of the candidates, with many scoring highly in the cloze procedure on the topic of classification. There was some inaccuracy in spelling of the specialist terms, but on the whole this question was well answered.

Q2 There was a good spread of results in this question. Part (a) involved identifying and explaining the decrease in haemoglobin's affinity for oxygen which occurs at reduced pH values. Many candidates found Part (a)(i) relatively straightforward, but a significant number did not obtain full marks in Parts (a)(ii) and (iii) since they failed to qualify that an *increase* in carbon dioxide levels or temperature would account for the outcome observed.

Part (b) was generally well done although in Part (b)(ii) some responses were rather vague and there were references to the oxygen levels in the water rather than in the tissue of the dolphin. This indicates the necessity for candidates to ensure that their answers are given in terms of the question set, rather than using the terminology of past paper questions with which they have become familiar during examination preparation.

Q3 This question proved to be surprisingly discriminating, possibly because of the novel nature of the stimulus diagram material in Part (a).

(a) Many candidates failed to identify the location of the sieve plates, selecting instead the plasmodesmata. Responses often included arrows which indicated loading/unloading of the phloem rather than the bi-directional nature of translocation.

(b) Frequently candidates responded incorrectly with "starch" for Part (i). Part (ii) was generally correctly answered using the stimulus material, but some candidates were penalised for responding in such a way as to clearly contradict the information in the pie chart.

Q4 In Part (a) candidates were asked to interpret a graph representing pressure changes in the cardiac cycle. It was clear that many candidates were very familiar with this type of

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graph and responses were good, but for others the complexity of the graph proved too demanding, and consequently scores were very poor. In Part (ii) a significant number of candidates misread the question and explained the cause of the semi-lunar valve closure, rather than the effect. Part (iii) was very accessible to all but the weakest of candidates.

Part (b)(i) proved to be very demanding and highly discriminating. This was a novel question, and tested AO3 – How Biology Works. Many candidates were unable to identify the evidence in favour of the link since they failed to compare data between the countries, instead focusing on just one. For the evidence against the link, a disappointingly large number of candidates attempted to compare two very different values i.e. "grams of fat" with "percentage of deaths".

Part (b)(ii) was quite well answered, though there were some vague responses which were not worthy of credit, or invalid references to lifestyle choices.

Q5 All parts of this question proved to be quite discriminating, with only the top candidates tending to score highly. In Part (a)(i) the acronym ASSI was not well understood by a significant proportion of candidates, and responses were often inaccurate, imaginative or omitted. Part (a)(ii) was frequently answered correctly with the given formula being applied to calculate the value for D.

(b) **(i)** Responses showed that some candidates did not interpret the D value properly and this part proved quite discriminating. There was often no appreciation of how small the difference between the two D values was. The command term "distinguish between" in (b)(ii) proved to be difficult for many candidates and often marks were lost as a result of vague or ambiguous descriptions.

(c) Although largely a factual response question, few candidates gave clear answers. Centres ought to emphasise to candidates the differences between terms such as "similar" and "same", and "sequence" and "pattern" to improve their performance in this type of question.

(d) Many candidates overlooked the necessity to explain "fully" and gave superficial responses. Often there were 'text-book' lists of the usefulness of aerenchyma which bore little relevance to the context of the question.

Q6 **(a)** The drawing of a line-graph proved to be surprisingly discriminating, since this is a skill which ought to have been well developed by candidates at this level. It was common to see errors in captions, where reference to the biological material was omitted. Similarly some candidates inverted the axes, showing a lack of understanding with regard to which of the values in the table constituted the independent variable and a small minority of candidates plotted bar graphs. The 'uneven' spacing of the light intensity values also escaped the notice of a number of candidates, who therefore failed to obtain the mark for using an appropriate scale.

(b) Most candidates correctly identified the most economical light intensity, and many of these went on to state why this was the case.

(c) This sub-part proved accessible for many candidates, though some candidates, having identified the term, failed to mention both the processes of photosynthesis and respiration.

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(d) **(i)** This proved to be a demanding question. Only a few candidates managed to obtain both marks available, often because they phrased their answer in terms of carbon dioxide uptake rather than in the terms of "growing" as the question asked. A small minority of candidates identified that species A had a low compensation point and therefore the rate of photosynthesis would exceed that of respiration even at a relatively low light intensity.

(ii) This was often well answered and appeared to be well understood by the majority of candidates, although 'stock' answers were evident in some cases, which did not explicitly refer to the material contained in the question.

Q7 This question proved to be fairly demanding and enabled discrimination between candidates.

(a) Many candidates recognised that the thin body shape would produce a short distance for the diffusion of gases. Often responses in terms of surface area: volume obtained only one mark, since a clear explanation of this adaptation was lacking.

(b) This was in the context of AO3, and as in Question 4(b) many candidates struggled with the demanding concept of analysing information from conflicting points of view. There were very few responses worthy of no credit, but similarly not many candidates obtained full marks in this sub-section. Lack of clarity and precision in language hindered some candidates in this question.

(c) The application of knowledge regarding gas exchange membranes to the novel context described proved to be quite demanding and only a minority of candidates were able to obtain both marks in this sub-section.

(d) The respirometer was generally well understood and many candidates obtained the three marks available for describing the experimental set up and procedure. However, many candidates overlooked the fact that the question was about determining the *rate* of oxygen uptake and consequently failed to achieve the essential marking point which referred to dividing the oxygen used/liquid rise by the time taken.

Q8 The essay question proved to be accessible for candidates and many scored well into double figures. In most cases, several detrimental farming practices were identified and an appropriately linked negative impact on biodiversity was noted.

Accounts were often quite extensive and in writing copiously, candidates may well have strayed from the point sometimes including 'remedies' for bad practice, which were not rewarded since they were outside the scope of the question posed. Similarly responses which were not specific to the detail of the question in regard to increasing area or yield in intensive farming were not rewarded either.

The marks for quality of written communication (QWC) displayed a marked improvement on previous series, and centres are to be commended for preparing candidates in such a way as to increase their written communication skills.

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Assessment Unit A2 General Comments

The A2 1 paper required candidates to recall biological knowledge, in addition to being able to apply their knowledge and understanding in the analysis and evaluation of a variety of stimulus material including a light micrograph, graphs, tabular data and calculations.

It is pleasing to report that there were many excellent responses to the more complex applied questions testing candidates' ability to apply their knowledge, understanding and skills in unfamiliar settings.

Assessment Unit A2 1 Physiology and Ecosystems

Section A

Q1 This relatively straightforward four-mark question required basic understanding of eye structure and function. The majority of candidates obtained three or four of the four marks available. While the question stem asked candidates to identify the term described by each of the statements given, some candidates achieved the mark by giving a clear description of the term. This was most frequent when describing the neurone arrangement that provides high sensitivity in low light intensities. For this part, a description of how several rods synapsed with one bipolar neurone in the retina was a worthy alternative to the term retinal convergence.

Q2 This question on the efficiency of energy transfer and secondary production in a cow proved to be an effective discriminator, although many candidates scored highly. The modal mark was five out of seven marks available. A significant majority of candidates were able to calculate the percentage of energy available for growth in the cow accurately in (a)(i). The most common error was only subtracting the value for respiration (1500 kJ m^{-2} $year^{-1}$) from the 4000 J $m^{-2}$$year^{-1}$ consumed, instead of subtracting all the energy losses from the food consumed to leave the proportion of energy available for secondary production. Part (a)(ii) was less well done. Many candidates appreciated that the high value for faeces is a consequence of cellulose (fibre) being very difficult to digest. However, only a small minority of candidates were able to link the high respiratory demand in the cow to it being an endotherm. Many candidates answered in terms of the cow using a lot of energy in its search for food. Part (b) was well answered. Most candidates were able to explain how confining livestock in small enclosed areas increased the efficiency of energy transfer [Part (b)(i)]. Reduction in movement and the increased warmth due to the close proximity of animals or them being kept indoors were common answers. In (b)(ii), the spread of disease was the most common correct answer.

Q3 Question 3 covered global warming and acid rain. The modal mark in this ten-mark question was six. While many candidates scored well, only a very small minority of candidates obtained all ten marks. Surprisingly, Part (a) proved to be the most discriminating sub-part. Many candidates gave explanations as to why carbon dioxide levels have increased from 1975–2005 as opposed to explaining the variations within any one year. Those who interpreted the requirements of the question accurately often produced excellent answers. Part (b) was well answered by many candidates. In (b)(i) most candidates showed good understanding of the link between rising levels of carbon dioxide, its ability to trap long wave radiation, and the rise in global temperature. In (b)(ii) a majority of candidates understood that the positive correlation between rising levels of carbon dioxide in the atmosphere and global

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warming does not necessarily indicate causation by man. Other correct answers included an understanding that there are other greenhouse gases, e.g. methane, and the potential of a long term cycle of global warming and cooling contributing to the recorded data. Part (c) required candidates to explain how acid rain was formed and then explain how it damages trees. Many candidates obtained one of the two marks available for Part (c)(i), through describing the gases involved (e.g. sulfur dioxide) in producing acid rain but failed to describe the acid (e.g. sulfuric acid) formed. Part (c)(ii) was generally well done; candidates produced a wide range of answers explaining how acid rain damages trees although the most common were answers linked to defoliation or changes to soil chemistry.

Q4 Muscle physiology was tested in Question 4. Most candidates scored between five and seven of the nine marks available. Identifying the features labelled A and B in the photograph [Part (a)(i)] proved challenging for many candidates. Common incorrect answers were myofibril (for muscle fibre) and mitochondrion (for nucleus). Many candidates found Part (a)(ii) more straightforward and the differences between skeletal muscle and cardiac and smooth muscle were well known. Part (b)(i) was well done and most candidates had an excellent understanding of the physiology of muscle contraction. However, it became apparent that many candidates produced well learnt answers explaining muscle contraction without answering the question specifically as it was asked. This explains why only a very small minority of candidates referred to changes in the length of the sarcomere in their answers. Additionally, very few candidates made reference to the removal of calcium ions from the sarcoplasm being linked to the lengthening of the sarcomere (and thereby relaxation of the muscle fibre). Part (b)(ii) proved more discriminating. A minority of candidates were able to explain that contraction involves many sarcomeres contracting at the same time and that the combined contraction enables a muscle to contract several centimetres. A number of candidates answered in terms of sarcomeres being stacked on top of each other (i.e. in adjacent myofibrils) and others answered in terms of myosin heads attaching and reattaching to actin therefore repeating the cycle of contraction.

Q5 This was a 13 mark question covering the population dynamics of yeast and the practical skills involved in using a haemocytometer. The performance of the candidature was normally distributed with most candidates obtaining between five and ten marks. In Part (a) a significant number of candidates failed to explain the lag phase in the context of the information provided. The stem of the question explained that yeast numbers increased as bud outgrowths from the parent cell reached an appropriate size before being detached. Consequently, answers such as 'time for egg production', 'time for egg and larvae development' and 'gestation period in mammals' were not rewarded. The decline phase of the graph was better understood. The determination of the carrying capacity of the yeast population represented by the graph was very poorly done [Part (b)(i)]. Many candidates failed to mention yeast cells in their answer and others either omitted units or used incorrect units. Part (b)(ii) was well done by many candidates, with the addition of extra glucose being the most common answer. A minority of candidates incorrectly noted that increasing the temperature of the culture would increase the carrying capacity. An increase in temperature (up to the optimum for yeast) would increase the rate at which the carrying capacity was achieved but would not change the carrying capacity itself. Part (c)(i) was well answered with a majority of candidates obtaining the correct answer. However, for those candidates who failed to gain both marks a frequent mistake was failing to calculate the volume of a type-B square (i.e. failing to multiply 0.04 by 0.1). Part (c)(ii) was usually well answered but again there was evidence of candidates failing

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to read or take note of all the information given. The answer that samples were taken at different times of the day was not acceptable as the stem of the question noted that the samples were taken at the same time. In (c)(iii) there were also many good answers. Many candidates were able to state that the glucose supply had not yet been exhausted or waste had not yet reached toxic levels. A small minority of candidates gained the mark by answering that dead cells could have been counted. Part (d) was well answered by the most able candidates. These candidates answered that the sample could be diluted in order to see the cells clearly for accurate counting and then stated that the cell count should be multiplied by the dilution factor. Many of those candidates who scored one of the two marks available missed the second mark by suggesting that 'the dilution factor should be taken into account', an answer that did not provide sufficient detail to gain credit. A surprising number of candidates failed to read the question accurately and answered in terms of using the 'North-West' rule to ensure accurate counting.

Q6 This seven-mark question on neurones was well answered. Most candidates scored between four and six marks; only the most able candidates obtained full marks. Both parts of (a) were generally well answered although a significant minority of candidates failed to answer (a)(ii) correctly. Some candidates drew a horizontal line through the axoplasm in diagram Y which would represent a longitudinal section and not the transverse section shown in diagram X. Others drew lines that represented planes of section through the nucleus or through the node of Ranvier – both clearly wrong based on the information provided by diagram X. Part (b) proved to be discriminating. Most candidates obtained at least one mark; usually for understanding the nature of saltatory conduction. A much smaller number of candidates scored two by being able to add that this was because the neurone did not become depolarised if covered by a myelin sheath and therefore myelinated neurones were only depolarised at the nodes of Ranvier. A similar situation existed for Part (c); most candidates obtained at least one mark but a relatively small number picked up the second mark. Most candidates could state that the giant axons in the earthworm facilitated faster impulse conduction. However, fewer candidates linked this faster impulse conduction to the earthworm, i.e. that this enabled a faster withdrawal response from a potentially adverse environmental stimulus.

Q7 Candidate outcomes were normally distributed around a modal mark of five in this nine mark question on immunity. Part (a), a synoptic question on protein specificity, was well answered. Most candidates were able to state that antibodies are proteins with specific binding sites that are complementary in shape to an antigen on the surface of a pathogen and so were able to pick up the three marks available. A minority of candidates made reference to the active site of the antibody and consequently failed to obtain the binding site mark. Part (b) proved to be more discriminating. Many candidates were able to suggest that antibodies have remained from previous infections as a consequence of antibody-mediated immunity. However, only a minority of candidates were able to suggest a suitable second reason for the presence of a range of antibody types in the horse. Previous vaccinations or passive antibody transfer (placental/colostral) from its mother were suitable answers provided by only a small number of candidates. Others suggested that there were different blood group antibodies in the serum; this was an appropriate suggestion and merited a mark. Part (c) was discriminating largely due to the applied nature of the question parts. Candidates were not expected to have prior knowledge of Kohler and Milstein's work on monoclonal antibodies but the more capable candidates were able to produce well thought out logical answers through using and applying the information provided.

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Part (c)(i) was often well done with candidates being able to explain that if the mouse was injected with one type of antigen then one type of antibody would be produced. Part (c)(ii) was very discriminating. Many candidates incorrectly suggested that the fusion of B-lymphocytes with tumour cells was to make the B-lymphocytes long lived or even the antibodies long lived. The key point was that the hybridoma cells are long lived. Part (c)(iii) also proved challenging with only a small minority of candidates achieving this mark. The most common correct responses included the idea that the use of hybridoma cells grown in fermenters would result in a larger or faster antibody production. Part (c)(iv) produced a wide variety of responses. This question allowed for a wide range of acceptable answers.

The most common answers that achieved the mark included:

- Antibodies did not have to be repeatedly removed from animals (horses).
- The removal of antibodies from horses could weaken their immune systems.
- Horses are pets/loved by humans whereas mice are pests/vermin.

Q8 This 13 mark question on succession proved to be a very effective discriminator. Most candidates obtained between 4 and 10 marks with a very small minority achieving 11 or more marks. Part (a)(i) proved more discriminating than expected. The correct answers either described the free draining nature of sand or the drying effect of strong winds as being the reason for marram grass requiring xerophytic adaptations in young sand dunes. Part (a)(ii) was well answered and most candidates were able to name a xerophytic adaptation. The five mark (b)(i) required candidates to analyse graphical information which included both abiotic and biotic data. Weaker candidates tended to describe each of the graphs in turn without linking the plant biodiversity to the abiotic data and therefore failed to score well. The best answers came from those candidates who were able to link the graphs together and provide a logical account explaining the reasons for the pattern of plant biodiversity shown in the graph. Part (b)(ii) was also discriminating. The best answers often described how light intensity varied through the day and also how rainfall or sunshine could affect soil moisture. Weaker responses vaguely described the weather as being responsible or that the incoming tide would affect soil moisture. Part (c) proved challenging for many candidates. A significant number of candidates referred to the nitrogen-fixing ability of gorse to improve soil fertility and therefore producing a better quality soil for plants that came later in the succession. They missed the key point that the gorse plants themselves could make nitrogen-containing compounds and therefore compensate for the poor quality soils that are present at an early stage of succession. Part (d)(i) was well answered and it was evident that most candidates knew the difference between a primary and a secondary succession. Part (d)(ii) was demanding and as expected only a small minority of candidates achieved this mark. Some of the excellent answers provided explained that a sand dune succession was spatial whereas a quarry succession was temporal, showing very good understanding of a major difference between the two successions.

Section B

Q9 The essay question concerning ultrafiltration, selective reabsorption and homeostasis in an osmoregulation context was generally well answered by a majority of candidates. Many candidates gave excellent accounts of the process of ultrafiltration and subsequent reabsorption in the proximal tubule [Part (a)] although there was often

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confusion as to the exact position of the basement membrane. Part (b) proved to be more discriminating but was often well done. A common misconception was that negative feedback was the converse of corrective action if the blood solute concentration became too high/low. Quality of written communication (QWC) was often excellent and usually good. However, some candidates produced essays that bordered on the illegible, making it difficult for examiners to read the candidates' response.

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Contact details

The following information provides contact details for key staff members:

- Specification Support Officer: Nuala Braniff
  (telephone: (028) 9026 1200, extension 2292, email: nbraniff@ccea.org.uk)
- Officer with Subject Responsibility: Patricia Quinn
  (telephone: (028) 9026 1200, extension 2267, email: pquinn@ccea.org.uk)