Rewarding Learning

CCEA GCE - Biology
(January Series 2013)

Chief Examiner's Report

Foreword

This booklet contains the Chief Examiner Report for CCEA's General Certificate of Education (GCE) in Biology from the January Series 2013.

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

CCEA hopes that the report will be viewed as a helpful and constructive medium to further support teachers and the learning process.

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

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GCE BIOLOGY

Chief Examiner's Report

Each of the three examination papers in the January 2013 series proved to be effective in allowing candidates to demonstrate their knowledge, understanding and skills. Again there was considerable evidence of the high quality teaching and learning taking place across the CCEA centres in this subject. Reports on individual papers will comment in detail on issues relating to each paper but it is worthwhile commenting on some common features at this point in an attempt to encourage centres and candidates to further improve on the high standard set.

Candidates, in general, attempt all the questions; there was little evidence of questions, or question parts, not being attempted. In this series, this applies to all three papers.

As in recent years, there is significant evidence that many candidates are not secure in their knowledge and understanding of scientific terms or definitions. This knowledge will continue to be tested in all units in future series.

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

Many candidates also lose marks through providing answers that are too general or not detailed enough. While this comment can apply to any question, it is perhaps most obvious in the essay questions. Further information concerning these points is supplied in the reports on individual papers.

It is pleasing to note that many candidates are making use of the 'Extra lined' page when requiring extra answer space. It is important that when used, candidates clearly indicate its use in the appropriate section(s) in the main body of the paper. However, there are still some candidates making unnecessary use of the supplementary answer booklet; booklets that often submitted unattached in any way to the examination paper. It is recommended that centres make all concerned, e.g. candidates, invigilators, aware of the extra lined page and the benefits of its use as opposed to the supplementary booklet. It is disappointing to note, that this is not the first time that this advice has been given in a report.

It is pleasing to report that a number of examiners commented on the improved quality of handwriting in this series. Hopefully, this is trend that will continue in the series ahead.

Assessment Unit AS 1 Molecules and Cells

This paper generated an extremely wide range of marks in the candidature and was successful in discriminating among candidates of different abilities. The paper enabled candidates to show the breadth and depth of their knowledge across the unit content. Some of the questions were more challenging than others, assessing more difficult concepts or the application of understanding to an unfamiliar situation (for example in parts (b) & (c) of question 5).

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

It is also worth noting that there has been a continued decline in the ability of many candidates to express themselves clearly. While this may be penalised within QWC in section B, some ideas were so poorly expressed in section A that marks could not be awarded, for example in question 5(c). Many candidates, including some of the more able, had trouble with spelling and the appropriate use of scientific terms.

Yet again many candidates penalised themselves, by not reading the question stem sufficiently well (for example in Question 8 (a)) or by failing to note all the information in the question.

Section A

Q1 This relatively straightforward question assessing knowledge of the processes associated with various cell structures proved very discriminating. It was generally well done but relatively few candidates scored full marks, with the role of the nucleolus in the formation of ribosomes least well known (a common answer here was mRNA, which showed a failure in reading the question carefully).

Q2 **(a)** This question concerning carbohydrates proved very discriminating. In Part (a) the similarities and differences between polysaccharides and triglycerides were generally well known. However, relatively few candidates obtained full marks, mainly due to incomplete answers or failure to make appropriate links.

(b) In Part (b) many failed to recognise Clinistix as the specific biochemical test for glucose.

Q3 **(a)& (b)** This question, which tested knowledge of the cell cycle, was generally well done. Parts (a) and (b) were correctly answered by a majority of candidates although only the best candidates described the appearance of chiasmata during metaphase of meiosis 1.

(c) Part (c) proved to be very discriminating with relatively few candidates completing the diagram correctly. Many candidates failed to draw the separated chromatids pointing in the correct direction and, while many did draw the spindle fibres correctly, a significant proportion of candidates failed to recognise that non-chromatid fibres should have been intact.

Q4 **(a)** This question, based on an electron micrograph of part of a villus in the ileum, produced the full range of marks, which showed a normal distribution. Part (a) was generally well done although relatively few candidates were able to identify all the structures.

(b) The calculation in Part (b) was extremely well done by most candidates. However, a significant minority who measured the length of the cell in cm, rather than mm, lost the conversion mark (as they only x1000).

(c) In Part (c) many candidates were able to suggest two organelles that would be present in Cell A but many lost the other 2 marks by giving general definitions of terms rather than an explanation that was specific to Cell A (e.g. "ribosomes, used in protein synthesis"). Also many candidates gave the 'nucleus' as one of the organelles despite being asked to name another organelle that is not distinct in the photograph. Some candidates were confused by the term 'organelle' and instead named a cell type (e.g. goblet cell) instead of an organelle within a cell.

Q5 **(a)** **(i)** In Part (a)(i) of this question most candidates were able to identify evidence for secondary and quaternary structure in the diagram of the collagen molecule but some lost marks by merely giving definitions, rather than relating it to the diagram shown (e.g. secondary structure is an alpha-helix or a beta-pleated sheet).

(ii) Part (ii) proved to be more testing with relatively few able to relate the triple helix arrangement shown in the diagram to the great strength required by tendons.

(b) Part (b), concerning the positioning of amino acids with hydrophobic R-groups, was well done by most candidates.

(c) **(i)** In Part (c)(i) only a small minority recognised that the solute potential would increase and many candidates stated that decreasing solute potential causes an increase in water potential.

(ii) However, in Part (ii) many then went on to correctly describe what happened when the water potential of plasma is higher than that of the red blood cells.

(iii) In Part (iii) only a few candidates were able to describe why a lack of albumen would cause water to accumulate in the abdominal cavity.

Q6 **(a)** In Part (a) it was very pleasing that the majority of graphs were accurately plotted with both axes labelled. However, many candidates did lose a mark by joining the points with a curve rather than short, straight lines. A significant minority also lost the title mark by not referring to 'rate of reaction' or the name of the enzyme.

(b) **(ii)** In Part (b)(ii) many candidates recognised the need to repeat at smaller intervals. However, very few specified that this should be in a specific range on either side of the optimum they had identified.

(iii) Answers for Part (iii) varied considerably, from those who correctly explained a thermophilic bacterial source or immobilisation, to those who suggested that the enzyme did not come from a human. A few simply discussed how temperatures above 37°C would denature the enzyme.

(c) In Part (c) many candidates did not recognise the importance for both the enzyme and casein suspension to reach the same temperature before mixing.

(d) In Part (d), the use of a buffer to maintain pH was well understood but only the better candidates were able to explain why pH needs to be maintained at the optimum level. It is disappointing at this level to find many candidates still referring vaguely to 'denaturation' or 'breaking bonds' rather than specifically identifying that it is the ionic bonds that are affected by pH.

Q7 **(a)** This question concerned the structure of DNA and its replication, both naturally in the cell and by PCR. In Part (a) the bonds within the DNA molecule were generally well known.

(b) In Part (b) semi-conservative replication was well explained by many candidates. However, a significant number lost marks by vague references to 'half old and half new' (in some cases it was clear what candidates meant by 'half' as they had drawn a small labelled diagram).

(c) Part (c) was based on the experiments of Meselsöhn and Stahl. Here only the best candidates scored highly. It is also worth noting that a significant minority did not answer (ii) (possibly because there were no lines to write on!).

(d) In Part (d) the technique of PCR was well known and most candidates were able to give two examples of how the technique can be used.

Section B

Q8 **(a)** Part (a) of this prose question required candidates to describe the similarities and differences between the structure of a bacteriophage and HIV. While there were some excellent answers a significant number of candidates mixed up the two viruses or concentrated on their mode of infection and spread rather than their structure. Many candidates gained some of the marks via appropriately labelled diagrams.

(b) Part (b), concerning the similarities and differences in the structure of a bacterial cell and an animal cell proved to be more straightforward and there were many detailed and well written accounts. However, as is common in questions of this type, many candidates give only half of a comparison (for example, 'DNA in bacterial cells is circular, while in animal cells it attached to histones' – these are actually halves of two different comparisons). Quality of written communication was often good, with many well-sequenced accounts that incorporated sound biological terminology. This is an area where standards appeared to be slipping in recent years, so it was pleasing to find some improvement in this examination. Many candidates had done brief 'essay-plans' which proved helpful.

Assessment Unit AS 2 Organisms and Biodiversity

The candidates taking this paper achieved a wide range of marks with very high marks achieved by those most able and best prepared. The paper also enabled less able candidates to indicate the extent of their knowledge and although there were some challenging questions, no answers proved to be unattainable. For example, in some cases the reasonably demanding calculation question 7(a) was poorly answered by more able candidates, but some weaker candidates were able to obtain full marks.

There was evidence that centres had provided helpful support and guidance for candidates undertaking this paper and there was a high standard of answering in most of the topics; though there were relative areas of weakness in some areas of the specification. There was no evidence to suggest that candidates struggled to complete the paper in the allocated time and most questions were attempted.

As in previous examinations, many candidates lost marks due to their inability to express and communicate their biological knowledge clearly and unambiguously, particularly in questions 2 (a), 7 (a)(iv) and 8 (b). Weakness in this area meant that the awarding of full marks for QWC in Section B was not as common as one would have expected in candidates who are studying at this level.

Section A

Q1 The majority of candidates scored highly in this question which proved to be a good introductory question for the paper. Spelling of fibrinogen was often inaccurate and the most common error was made in the fourth part of the question.

Q2

(a) Some candidates struggled with Part (a) and so this question proved to be quite discriminating. Some responses were too general, with vague references merely to habitat loss and there was some confusion evident, particularly as to the adverse effects of drainage.

(b) Part (b) was well answered, with many responses worthy of full marks.

Q3 There was a good spread of marks in this question, which involved candidates interpreting a diagram and applying their own knowledge.

(a) Many responses were correct, though a few candidates confused the two terms.

(b) This sub-part proved most problematic, though few candidates failed to obtain at least one mark. Common errors included lack of precision in regard to describing the role of plasmodesmata and responses describing how lignification strengthened the whole plant.

(c) This was challenging for less able candidates who displayed a degree of confusion between the processes of diffusion and evaporation. A number of candidates also incorrectly referred to osmosis at location A. A small number of candidates failed to draw from the question that they ought to refer to processes in their response.

Q4 Practical skills in the context of ecology were tested in this question.

(a) **(i)** This sub-part was generally well answered; candidates have a good awareness as to the sampling applications which require either random sampling or line-transect sampling. In some cases the random sampling procedure described quadrat throwing or dropping over the shoulder. Centres should be teaching candidates the preferred methodology as referred to in the published mark scheme.

(ii) This question was well answered by most candidates.

(b) As in previous examinations, the inability of many candidates to differentiate between the concepts of reliability and validity was responsible for only a few candidates achieving full marks in Part (b). Centres are reminded that in AS examinations, approximately 15% of the marks available will be drawn from Assessment Objective 3: How Biology Works, and that teaching candidates how to evaluate methodology ought to extend beyond that which is undertaken in coursework.

(i) Most candidates realised how the reliability of the sampling could be improved but only the most able could identify why a small sample was less reliable than a larger one.

(ii) There were very few correct responses suggesting how validity of the procedure could be improved, with most attempts describing rather how to improve reliability.

Q5 **(a)** **(i)** The identification of the structures in the photograph was generally well done, albeit with some aberration in spelling.

(ii) The majority of candidates were able to identify at least one feature which indicated that the photograph showed the left side of the heart.

(b) **(i)** Many candidates included irrelevant detail in their responses with an extended account of stimulation commencing at the SAN. Whilst this was not penalised, candidates should be reminded to look at the marks available as a guide to the level of detail expected and select appropriate information from their knowledge. In some accounts, candidates were penalised for describing the increase in ventricular pressure in the context of ventricular filling, rather than due to ventricular systole.

(ii) The majority of candidates gave the correct response.

Q6 **(a)** The definition of species was given correctly by all but the least able of candidates.

(b) **(i)** The skill of developing a dichotomous key was tested in this question, and many candidates were successful in gaining full marks. There was a significant amount of material provided and the initial first statement of the key provided a good foundation upon which candidates could build. A small minority of candidates seemed unfamiliar with the concept of dichotomy and erroneously included three or more alternatives in the stages which they constructed. The other common mistake was to include a 'circular' instruction within the outcomes such that the key was unsuitable (e.g. including 2 as one of the outcomes for statement 2).

(ii) This question was well answered.

(iii) The majority of candidates identified the correct species, but a significant minority offered an unsatisfactory explanation by referring to the observable features rather than the more straightforward difference in genus.

Q7 This question proved to be quite demanding and allowed good discrimination between candidates.

(a) **(i)** The calculations of surface area and volume elicited mixed responses with some weaker candidates gaining full marks and more able ones scoring zero.

(ii) The more demanding calculation here was less likely to be correct than in Part (i).

(iii) There were many candidates who were able to identify the need to increase surface area to allow increased activity, but fewer linked the idea to the increased demand for oxygen which activity creates. This was one of the questions where candidates' lack of clarity in communication was evident.

(iv) Responses frequently obtained one mark for correct references to surface area: volume but occasionally the ratio was inverted. Very few candidates were able to convey the idea of relativity or proportionality

for the second marking point and made misleading statements which implied that smaller animals absorbed greater volumes of oxygen than larger ones.

(b) Many candidates did not select relevant information from their knowledge in answering this question, but simply wrote down as many of the adaptations of gas exchange surfaces as they could recall. The most common single mark answer referred to the large number of alveoli present in the lungs.

Q8 This question also proved to be quite discriminating with a very small proportion of candidates getting high marks. Surprisingly, some candidates performed better in Part (b) which was more demanding than (a).

(a) **(i)** There was very poor answering in this question. Percentage saturation is a commonly used term but clearly misunderstood by the majority of candidates. The idea of relative amount of haemoglobin was frequently omitted and many answers were incorrectly framed with reference to amount of oxygen.

(ii) The reading from the graphs and calculation of difference were well done.

(iii) Most candidates identified A as the correct option, and many gave at least one valid point in their explanation. Occasionally candidates described both aspects of the first marking point for the explanation and therefore failed to obtain the two marks available.

(b) Responses to each of the three sub-parts often lacked detail and clear communication of candidates' knowledge.

(i) Commonly a single mark was obtained for recognition that more haemoglobin enabled more oxygen to be transported, but far fewer candidates linked this with the concept of less oxygen being loaded.

(ii) Many candidates recognised that more air would be taken into the lungs but failed to refer to the rate of air intake. However, many correctly identified that this adaptation compensated for the lower partial pressure of oxygen which exists at high altitude.

(iii) There was a slightly better performance on this question sub-part, with a significant number of responses achieving two of the three possible marking points listed in the mark scheme. A common error was to state that dilated blood vessels would cause the rate of blood flow to increase and there were few candidates whose response was specific enough to name the blood vessels involved.

Section B

Q9 **(a)** The first part of the essay required candidates not only to list xerophytic adaptations but to explain how these features enabled survival in environments in which water was in limited supply. Many candidates scored well in this sub-part, although some marks were lost through vague descriptions of water loss and evaporation.

(b) The second sub-part on natural selection was generally less well handled by candidates and there was evidence that some candidates were not well

prepared for this topic. On the whole, the difference between directional and stabilising selection seemed to be well understood, but there were some recurring issues of gross confusion across the candidature. References to individuals within the population suddenly adapting to an environmental change were common, rather than the idea of naturally occurring editing the variation already in existence. There were also some erroneous references to speciation rather than concentrating on changes within a population.

Directional and stabilising selection are often taught (and can well be described) with graphs of feature versus frequency, but often when candidates tried to use these in their account, axes labels were omitted, so no credit could be given.

As in previous years full marks for QWC proved to be difficult to award in many cases, particularly due to poor sequencing of information or loose terminology, particularly evident in sub-part (b).

Assessment Unit A2 1 Physiology and Ecosystems

This paper was also very effective in discriminating among candidates of different abilities. In general, the most able candidates performed well throughout the paper, although only a very small number of candidates scored in excess of 80 of the 90 available marks. Many other candidates tended to have particular difficulty with those questions involving application of knowledge in unfamiliar contexts. This was particularly evident in question parts 2 (b), 3 (b) (i), 4 (a)(iii), 6 (a) and 8 (b).

Section A

Q1 This question required basic knowledge of phytochrome. Many candidates obtained all three marks available, with three being the most common mark awarded for this question. Candidates who failed to obtain three marks tended to mix up P660 and P730 or darkness and light.

Q2 Question two was a six mark question on the kidney requiring an understanding of water potential in a filtration context.

(a) Parts (a) (i) and (ii) were well answered with the most common mistake being mixing up afferent with efferent.

(b) Part (b) proved to be more discriminating; a significant number of candidates were able to correctly calculate the water potential for the plasma and the filtrate, but having got this information, were unable to calculate the net filtration force.

(c) Part (c) proved to be the most discriminating question part. Many candidates understood that the protein was filtered into the nephron due to high pressure but failed to extend their answer to note that the reason it appeared in the urine was that it was not reabsorbed.

Q3 Question three, based on reed bed systems and the nitrogen cycle, proved to be very discriminating with a significant number of candidates obtaining between three and six of the nine marks available; however, only a very small minority scored 8-9 marks in this question.

(a) In part (a) a majority of candidates scored one out of the two marks available, being able to link the more frequent rain in winter/frozen ground to increased run off. Only a minority of candidates obtained a second mark by stating that there is less plant growth in winter and that the fertiliser is less likely to be used by the plants.

(b) **(i)** In Part (b)(i) only the most able candidates were able to understand the significance of the 'localised gradients in oxygen levels' being important in encouraging the reduction in nitrate levels in the water across all oxygen gradients. While many candidates produced correct answers concerning aerobic decomposers and the process of nitrification, a significant number made oblique references to denitrifying bacteria being an anaerobic process. The most able candidates were able to answer that denitrification, in the reduced oxygen levels, could further reduce nitrate levels in the water by converting nitrate to nitrogen gas; a beneficial process in this particular context.

(iii) In Part (b)(iii) a pleasing range of well thought out answers was evident although generalised answers such as reducing eutrophication did not gain credit as the context of the question required answers specific to reed bed systems.

(c) Part (c) requiring the linking of UV radiation and cataracts/skin cancer was very well answered by a majority of candidates.

Q4 **(a)** Part (a) of this question about the eye also proved to be an effective discriminator. A significant number of candidates were able to identify layer X in the photograph as being the choroid.

(ii) A smaller proportion was able to identify the structures labelled Y as being nuclei in Part (ii); mitochondria being the most common incorrect answer.

(iii) Part (iii) requiring an interpretation of the 'inverted' retina was well answered with many candidates showing good interpretative and analytical skills.

(b) Part (b) was well answered, with a majority of candidates showing a good understanding of the structure of the retina and the significance of the different neurone arrangements. However, the distinction between retinal convergence (an anatomical detail) and spatial summation (a physiological advantage) was not always well understood.

Q5 This question on phytoplankton and the haemocytometer was generally well done. Marks obtained were normally distributed around a mean of ten out of the fifteen marks available for the question.

(a) Part (a) was based on an interpretation of a graph of phytoplankton growth superimposed on a range of abiotic data. Candidates generally performed well in this section, although in Part (iii), a significant number failed to appreciate that there would be a time delay between the peaks and troughs of the phytoplankton and the zooplankton.

(b) Sections (b) and (c) covered sampling and calculation techniques involving the haemocytometer. A surprisingly large number of candidates failed to gain the

two marks available in (b)(iii), a question part requiring the calculation of the phytoplankton per unit volume. A significant number of candidates tried to calculate the volume of a type-C square rather than a type-B square. Additionally, many candidates simply multiplied the value given for the area for a type-B square by the number of phytoplankton without calculating the volume.

(c) Part (c) focusing on sampling techniques and validity was generally well done.

Q6 This question covered ecological features of hedgerows and a comparison of sampling techniques. It proved to be very discriminating with the majority of candidates scoring between three and six of the nine marks available, with only a very small minority obtaining full marks.

(a) Part (a) was a comprehension involving a comparison between typical hedgerows in Fermanagh and East Down. Only the most able candidates were able to select the most relevant pieces of information and develop these to account for the differences in species-richness in the two areas.

(b) Part (b) involved a comparison between the sampling technique described in the question and Simpson's index; this was generally quite well done.

(c)& (d) Parts (c) and (d) requiring an understanding of why hedgerows are not climax communities, and the link between the removal of hedgerows and increased soil erosion respectively, discriminated well. Only the most able candidates achieved all the three marks available in parts (c) and (d).

Q7 This eleven mark question covering cell-mediated immunity and rhesus incompatibility was often well answered, showing sound understanding of the concepts involved. A majority of candidates scored between six and nine marks.

(a) **(ii)** Part (a)(ii) proved to be very discriminating with only a very small minority of candidates answering with the clarity and detail required to secure both marks. To obtain both marks it was necessary to both define cell-mediated immunity and explain why it did not fit the definition of an antibody-mediated response.

(iii) Part (iii), a four mark question part requiring a description of cell-mediated immunity was well done by most candidates. A small minority of candidates provided an explanation in terms of antibody-mediated immunity.

(b) Part (b) required an understanding of the sequence of events associated with rhesus incompatibility. While good understanding was evident, only a minority of candidates achieved all four marks available. Many candidates were confused as to whether the agglutination took place in the mother or the child and referred to treating the mother with immunosuppressant drugs. There was often vagueness as to what exactly caused the immune response in the mother with diffusion of 'blood' from the foetus being a common response. The best responses showed tight alignment and logical sequencing between their descriptions and the consequences of the rhesus status of the children listed in the table.

Q8 The modal mark for this question on the nervous system was nine, although only a very small minority of candidates obtained all twelve marks available.

(a) **(i)** Part (a)(i) proved to be surprisingly difficult for a large number of candidates with depolarisation being a frequent incorrect answer.

(ii) Part (a)(ii) was very well answered showing that candidates have a good knowledge of the sequence of events from resting potential to recovery following the development of an action potential, when asked in a straightforward context.

(b) Part (b) proved to be more discriminating with a significant majority of candidates picking up at least two of the four marks available. Generally, there was a solid understanding of the controlled variables likely to be important in this type of experiment on neurones although vague examples were not uncommon, e.g. 'same volume of bathing solution'.

(c) Part (c) was also usually well done with most candidates having an understanding of the ethical issues arising from this type of experiment, but also an understanding of potential benefits.

Section B

Part (a) of the essay required knowledge and understanding of energy flow through ecosystems. Part (b) was more applied, requiring an understanding the ways in which farmers can maximise productivity. There were many well written and logically sequenced answers with most of the candidature obtaining more than half of the available marks. Analysis of candidate performance indicated that a much greater number of candidates obtained maximum marks in Part (b) than in Part (a). A frequent cause of dropped marks in Part (a) was the presentation of vague or general answers rather than the development of more detailed answers. For example, the first marking point in (a) required candidates to note that less than 1% of solar energy was absorbed by plants rather than the more general comment that the absorption of light energy by plants is inefficient. Additionally, a significant number of candidates answered in considerable depth about the reasons for the inefficient absorption of light energy by plants with often a much more truncated account of energy flow through subsequent trophic levels.

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