Rewarding Learning

CCEA GCE - Biology
(Summer Series) 2014

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 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

As in recent summer series, each of the four examination papers in summer 2014 provided further evidence of the high quality learning and teaching taking place in centres taking CCEA A level Biology. In later sections of this report, individual papers will be reviewed in detail.

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

As has been the situation in recent series, many candidates lost marks through not interpreting the question exactly as it was asked or through lacking the appropriate level of detail expected at A level.

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

AS Assessment Units

General

Each paper had a similar structure to previous papers and candidate performance was broadly similar to previous series.

Assessment Unit AS 1 Molecules and Cells

This paper generated a wide range of results and successfully discriminated among candidates of differing abilities. 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. In addition, a significant amount of reading was required in order to answer several questions (for example, Question 5, Question 6 Part (b) and Question 7), and it is pleasing to note that many candidates coped well with this.

As always, however, there were some question parts which proved very challenging across the candidature (for example, Question 7). In addition, the perennial problem of misreading the question and/or using incorrect or vague terminology caused many candidates to lose marks. It was pleasing to note that the practical skill of presenting results in tabular form and the interpretation of these results, as assessed in Question 5, was done well by the majority of candidates. However, it is worrying to note that a significant minority did not attempt to construct the table.

Yet again legibility continues to be a real problem in some scripts. Also many candidates show poor communication skills – for example using 'it' and 'they', thus expecting the examiner to work out what is being referred to.

There was no evidence that candidates were short of time in this examination and there were no questions which were not attempted by a significant number of candidates.

Q1 This question concerning structure and function of the ileum was generally well answered. The majority of candidates correctly identified tissue 'X' as the mucosa and the function of goblet cells as mucus secretion. However, the function of Paneth cells was more differentiating among the candidates, with many confusing them with the stem cells.

Q2 This question concerning nuclear division by meiosis differentiated well between the candidates.

A large number of candidates could correctly identify stage B. However, a small minority still lack precision by simply stating 'prophase'. In Part (b) the major issue for many candidates was the sequencing of their thoughts concerning events involving behaviour of the chromosomes between stage A and stage B. Too many candidates described correct events but in a completely random sequence and were penalised accordingly. For example, chromosomes (not homologous pairs/bivalents) lined up at the cell equator and then crossing over occurred, followed by bivalents forming. Candidates must pay more attention to the correct sequencing of events when formulating answers to such free response questions.

Q3 This question involved identification of structures within an electron micrograph of a photosynthetic plant cell, calculation of true size (in μm) and relating structure to function concerning the internal membrane system of a chloroplast. The question was differentiating among the candidates.

(a) In Part (a) some candidates identified A as 'starch', not realising that it is impossible to see starch molecules at a magnification of x7500.

Structure B (tonoplast) and structure C (middle lamella) were generally well known. Common errors included vacuole for structure 'B' and plasmodesmata for structure C.

(b) Part (b) concerning calculation of true size (in μm) proved to be differentiating among candidates. A significant minority still do not show their working out and so lose all marks if their answer is incorrect. Candidates need to realise that one incorrect step will only lose one mark and other marks can be awarded consequentially. A large number of candidates could not even accurately measure the length of the line (X-X) marked on the micrograph, in either cm or mm. Unit conversion also caused problems for many candidates. This skill requires more practice by candidates.

(c) In Part (c) the relationship between the internal membrane system of a chloroplast and the ability to maximise light absorption was poorly understood by many of the candidates. While many correctly stated that folding of the lamellae increases the surface area of this internal membrane system only a minority could link this with more space for accommodation of more chlorophyll molecules. The majority simple restated what was in the question stem – i.e. 'the greater the absorption of light energy'.

A common error was to state that the 'membrane system is transparent', when in fact the opposite is true, as this is where light energy is absorbed.

(d) In Part (d) it was worrying to see that many candidates think that 'plant cells do not have a nucleus'. Other candidates suggested that the reason why the nucleus was not visible was that the cell was dividing (possibly as a 'legacy' from Question 2). Candidates need to appreciate that specimens used in transmission electron micrographs are ultrathin sections and therefore some organelles will not be present in every section.

Q4 This was a good differentiating question concerning enzyme activity in biological washing powders.

(a) Description of the trends was generally not well done as the majority only gave the first part of the trend. The most common error was describing a **rapid** decrease in enzyme activity at temperatures above the optimum of 40^0C. As the independent variable here was temperature and not time it was therefore inaccurate to refer to speed of decline in enzyme activity at temperatures above the optimum. The enzyme activity fell sharply/crashed/showed a dramatic decline, would all have been appropriate descriptions.

The majority of candidates were able to explain that increasing the temperature from 5^0C to 40^0C increased the enzyme activity by adding kinetic energy to both the enzyme and substrate molecules, and thereby increased the frequency of successful (formation of ES complexes) collisions. Many candidates did not access the last available mark as they simply stated that the enzyme denatured at temperatures above the optimum (40^0C) (this is a GCSE answer). Some detail of breaking of H-bonds within the tertiary structure/distortion of the enzyme active site was required.

(b) **(i)** The two peaks in the graph represented two different enzymes present in the biological washing powder, each with a different temperature optimum.

(ii) In Part (ii) many candidates could not relate this to the range of temperatures used in washing machines.

(c) Many candidates who did not realise that the two peaks represented two different enzymes with different temperature optima, struggled to explain the enzyme activity between 45^0C and 55^0C. However, a significant number of candidates could answer this part and also answered (b)(i) within it. Some candidates thought that the denaturing of the enzyme between 45^0C and 55^0C was reversible. Other candidates thought that the enzyme was able to 'adapt' after 50^0C and 'become active again'.

Some candidates ignored the question and instead hypothesised that 'more substrate had been added, thus explaining increased rate of reaction'.

Q5 **(a)** **(i)** In Part (a)(i) table construction to display the results of the biochemical tests on the five 'unknown' test solutions was well answered by the vast majority of candidates. However, a significant minority failed to attempt this part (maybe because there were no lines to write on).

(ii) Part (ii) was generally well answered with the majority scoring at least three marks. The most common error was identifying substance C as sucrose.

(iii) In Part (iii) the most common error was not heating the mixture of the test solution and Benedict's reagent.

(b) This question was more differentiating with many candidates wrongly identifying substance E (sucrose) as maltose/glycogen/cellulose. However, these candidates were still able to access the second mark by explaining that once hydrolysed, substance E released glucose which tested positive for both Benedict's reagent and Clinistix.

Q6 **(a)** **(i)** Part (a)(i) asked candidates to identify the elements present in all proteins. A common error made by candidates was confusing the term 'elements' with 'monomers' and so incorrectly answered 'amino acids' instead of C, H, O and N. While S is present in some amino acids, such as methionine and cysteine, it is not present in **all** proteins.

(ii) In Part (a)(ii) the concept of quaternary structure of a protein as one which consists of more than one polypeptide chain, was generally well known by candidates. However, a significant number of candidates confused quaternary structure with conjugated proteins or gave both definitions in their answer, thus expecting the examiner to choose the correct one.

(b) **(i)** Part (b)(i) was generally well answered, with the majority of candidates scoring at least three marks. Again many candidates expected the examiner to choose between two (or more) answers (only acceptable if both are correct responses).

(ii) In Part (b)(ii) only a minority of candidates were able to suggest that amino acids present in some shampoos are not absorbed and therefore cannot be used for keratin production within cells. The most common answer suggested that the amino acids in the shampoo would not be in the correct sequence and therefore could not be used for synthesis of keratin.

(c) In Part (c) the majority of candidates failed to apply their knowledge of organelle function to the sequential synthesis of proteins (even though this was in a recent essay question). The majority stated simply that the role of ribosomes is the site of protein synthesis (which was in the question stem) rather than synthesis of polypeptide/primary structure/initial protein. The role of RER in transport of the polypeptides to the Golgi apparatus was understood by most candidates. Those candidates, who simply stated that the RER is where ribosomes are attached, scored this mark rather easily. The role of the Golgi apparatus in modification of the polypeptide by coiling (secondary structure) or folding (tertiary structure)/conjugation, or production of lysosomes/secretory vesicles was better understood by candidates.

(d) In Part (d) the term 'exocytosis' used to describe fusion of vesicles with the plasma membrane to achieve secretion was well known by candidates. A minority of candidates were confused and stated pinocytosis/phagocytosis.

(e) This mark was easily accessed by candidates.

Q7 Many candidates found this question challenging and it was differentiating.

(a) Part (a) asking candidates to identify similarities between the structure of the herpes virus illustrated and that of HIV and a bacteriophage was well answered by most candidates.

(b) **(i)** In Part (b)(i) only some candidates were able to recognise that PCR is an expensive technique which would be pointless unless there was some evidence (change in appearance of the nucleus) of viral infection.

(ii) In Part (b)(ii) candidates often missed the easy answer here i.e. that 'dead or open oysters' may result from many causal factors and not necessarily from infection by OsHV. Consequently the 'obvious signs' method is the least **reliable** in diagnosing infection by this virus.

(iii) In Part (b)(iii) very few candidates scored any marks here as most candidates referred to production of multiple copies of DNA using PCR, thereby focusing on PCR instead of the subsequent DNA analysis. Alternatively candidates just stated that PCR was 'specific and sensitive' with no further elaboration.

(c) Overall, Part (c) was well answered, with a majority scoring three or four marks.

(i) In Part (c)(i) most candidates were able to identify DNA polymerase as the enzyme used in PCR. The most common errors here included 'restriction endonuclease' or simply 'polymerase'.

(ii) In Part (c)(ii) the majority could recognise that four types of deoxyribonucleotide must be included in the PCR procedure, reflecting the four types of nitrogenous base involved in genetic coding. However, a significant minority confused nucleotides with amino acids and so gave '20' as their answer.

(iii) In Part (c)(iii) the majority of candidates were able to correctly state the complementary base sequence to which primer C10 would bind.

(iv) In Part (c)(iv) a significant number of candidates failed to recognise the double stranded nature of DNA and instead gave answers from previous questions concerning the identification of the relevant section of DNA.

(v) Part (c)(v) was generally poorly answered with many candidates failing to recognise that it was necessary to eliminate oyster DNA in the DNA extracted from infected tissue samples (thus facilitating design of DNA probes specific and complementary to the OsHV DNA). The most common answer was 'to produce primers complementary to the infected sequence of DNA'.

Q8 This free response question concerning the process of osmosis in cells and the effect of changing the external solute concentration was well tackled by candidates, but still provided differentiation.

The better answers were well sequenced and used correct and an appropriate level of terminology whilst framing their discussion, reflecting sound candidate preparation in terms of knowledge base and good planning of their essay. However, many candidates failed to score full marks because they concentrated on the effect of the external solutions on cells and forgot about the process of osmosis. It was also disappointing to see many candidates referring to 'concentration of water' rather than water potential (especially as in recent short answer questions water potential appears to be well known). Confusion still exists between solute potential and water potential, with a significant number of candidates stating that increasing solute potential causes a decrease in water potential. There was also confusion between lysis (in animal cells) and plasmolysis. Many candidates also showed lack of understanding in their use of the terms hypotonic and hypertonic.

In general, there was good quality of written communication but it continues to be a skill that needs much development in some candidates. While sequencing of ideas has improved there is scant regard to spelling, punctuation and grammar by some of the candidates.

Assessment Unit AS 2 Organisms and Biodiversity

The candidates taking this paper obtained a wide range of marks. Some obtained high marks displaying a sound grasp of the subject content and well developed skills in application. However, very few candidates obtained the highest marks. Many questions in the paper also enabled less able candidates to indicate the extent of their knowledge and although some questions proved to be particularly challenging, none were beyond the ability of the candidates as a whole. Comments on individual questions and responses appear below.

There were very few scripts with a significant number of blank spaces and in most questions candidates attempted to respond. Many centres had clearly prepared the candidates to a very satisfactory standard and there was evidence that the content of the specification had generally been well taught. However, in covering the specification, centres should bear in mind the three assessment objectives listed in section 4.2 of the specification. This paper suggested that for some candidates, aspects of Assessment Objective 3 – How Biology Works, proved unfamiliar.

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. In this case, they either failed to address the question entirely or only gave partial answers thereby preventing themselves from accessing all the available marks.

It is important for candidates to spell correctly technical terms such as prothrombin, thrombin and fibrinogen.

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

Q1 This was a straightforward recall question and proved to be mostly accessible, although a small minority of candidates appeared to have difficulty with the thickness of the membrane and the concentration gradient. Almost all candidates showed a good understanding of how the components of Fick's Law affect diffusion.

Q2 Candidates answered this question well generally. Many candidates gave the appropriate answer for the acronym SAC (but there were some unusual suggestions also). In Part (c) candidates often failed to link the idea that the native species used for hedgerows provide food and shelter for native species of animals.

Q3 This question related directly to a practical procedure, with which, candidates should be familiar. Many candidates scored very well. However, a significant number obtained no marks. Some candidates described how the air sample is trapped in the J-tube, although the question already showed the sample in place. A significant number of candidates did not know the sample should be treated with KOH to remove CO_2 and some indicated that pyrogallol or another chemical should be used. Candidates obtained other points on the mark scheme successfully. This question proved relatively discriminating and it was clear which candidates had experience of the technique and those who did not.

Q4 This again was a discriminating question on the paper, with only a small number of candidates scoring highly, although no sub-part proved to be completely unattainable.

(a) This was very poorly answered and candidates clearly do not understand the meaning of accuracy (i.e. the degree to which the measurement represents the true value of the attribute being measured) often giving answers more suited to reliability or validity.

(b) A significant number of candidates chose the non-grazed area as having higher biodiversity showing a misunderstanding of the index values and making it unlikely they would achieve the second mark.

(c) Very few candidates suggested why few of the parasites would be found in the pitfall trap.

(d) The main problems arising involved responses at a GCSE level identifying phagocytes and phagocytosis as the cells and mechanism. Confusion of the roles of B and T cells was also apparent. At this level candidates would be expected to give the names of cells associated with mechanisms and not just cite the mechanism.

Q5 This question proved relatively discriminating for candidates of different abilities.

(a) The definition of a lysotroph was difficult for many candidates, with many referring to extracellular digestion (common to other organisms) or to decomposition of dead material but not effectively linking both.

(b) Many candidates answered this well but the range of incorrect answers was surprising.

(c) Candidate response was variable in this section, with few achieving three marks. Failure to look at structures present in the photograph or to use information supplied was a root cause of the problem.

(d) Generally answered well.

Q6 This was a novel style of stimulus material but in general candidates responded well and performed well in this question. In Question 6(a) many candidates had difficulty in defining the term 'order' even though it appears directly within the specification. Parts (b), (c) and (d) were answered well. In Part (d)(iii) the calculation of percentage difference between sequences posed problems for some weaker candidates. In Part (d)(iv) candidates often failed to achieve the mark because they did not compare the three organisms.

Q7 The graph drawing skill in this question seemed to pose problems for some candidates. The axes were drawn the wrong way round or distance was used as opposed to the instruction suggested by the graph title in the body of the question. Plotting skills and the nature of joining the points proved to be uncertain for many candidates (Graphical Techniques Guidance 2011 – available under the 'support materials' tab for revised GCE Biology on the biology microsite www.ccea.org.uk/biology). Many candidates lost the scale mark since their plots covered less than half the available plot area. Lines must be joined in a continuous fashion at points. Parts (b) and (c) were not well answered in many cases. Trends were often not identified, i.e. reference to a single highest or lowest value does not represent the trend; it is important to note that what happens between these points is worthy of comment. Explanations in many cases were vague at best and quality of written communication using appropriate technical language left much to be desired.

Q8 **(a)** This was generally well done. However, some candidates (as in the previous question) honed in on individual points and did not describe the trends shown.

(b) Candidates often indicated a possible reason for changes shown but then failed to qualify or link this to the biological impact of the change such as loss of food/nesting sites etc.

(c) This was also true for Part (c) with the added caveat that some candidates did not read the question fully as it referred to effects on land, not in watercourses. Therefore, eutrophication was not a suitable response. Many candidates also neglected to reference how biodiversity would be altered and simply gave the negative effect of adding fertiliser to the soil.

Q9 **(a)** This part required candidates to discuss the main structural adaptations of mammalian blood vessels. This was accessible to most candidates. However, some marks seldom appeared in accounts, for example, **very** narrow lumen of capillaries and the mechanism of valve closure. In general, the candidates could not simply state specification content directly without some modification.

(b) A large number of candidates did well in Part (b) of the essay question and should be commended for their recall of clot sequence. Again, unfortunately candidates lacked suitable technical language and the spelling of technical terms was in cases extremely poor. Full marks for QWC proved to be difficult to award in some cases often as a result of poor sequencing of information or inaccurate terminology. Centres must reinforce the importance of accurate spelling and use of technical terms.

Principal Moderator's Report

Assessment Unit AS 3 Assessment of Practical Skills in AS Biology

The work submitted by the majority of the centres tends to be limited to determination of water potential, beetroot membrane permeability and enzyme practicals. In the majority of cases, these were well completed by the candidates. Fieldwork studies were rare but, when undertaken by centres, they were of a high standard. It is important that the practicals chosen have a clearly identified hypothesis for the candidates to investigate. This will be important with the changes to the criteria which are occurring next year (from September 2014).

Marking continues to improve with many centres picking up on the standards required from attendance at Agreement Trials. Those centres with issues often have not been to Agreement Trials for a few years.

Annotation is generally good with many centres adopting the codes given on the CCEA criteria mark sheets for annotation. This is extremely helpful to the moderators, as is the inclusion of centre based mark schemes, when moderating the work.

There are still many cases of candidate record sheets not being signed by the candidate or the teacher and there were more instances of incorrect transfer of marks from the candidates' work to the candidate record sheet. Internal moderation was very evident in centres with more than one teaching group and this tended to be accurate in nature. There were a few instances when marks were changed by internal moderation but this was not implemented in the overall marks for the candidate.

Implementation

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

Recording and Communicating

The quality of tables and graphs has improved over the past few years. However, there are still many recurring issues. Captions have become too long and many have errors. This is particularly evident in any investigation involving a colorimeter with many pupils struggling to communicate effectively what is being measured e.g. the "effect of temperature on light transmission" has been frequently reported by candidates and not penalised.

Best fit lines have also caused discrepancies in teacher and moderator marks with many being inaccurately or inappropriately drawn. The moderating team would like to see both carrot and potato data being drawn on the same axes and preferably with solute potential on the x axis. If average/mean results are being plotted then this should be made clear in the caption or on the y axis.

Interpretation

As with previous years, there tends to be a range in quantity and quality in this section. The interpretation should make reference to the results and the I.V. being investigated and explanation of the trend and written communication should not just be a listing of each of the results.

The depth of knowledge should be commensurate with what is expected at AS level and the marks awarded should reflect the standard required for examination answers. Again there were issues of confusion between incipient plasmolysis and isotonic point when determining water potential; and in the same practical many candidates give very little reference to the effect of storage sugars on the water potential which is the crux of the investigation.

When investigating the permeability of membranes, all possible effects on the membrane were frequently not discussed by the candidates.

Evaluation

As identified in previous years' Principal Moderator's reports, this section continues to cause confusion and problems in standard across all centres. Again attendance at agreement trials would help teachers to understand what is required for each skill area. Some areas to arise this year would be the absence of what could be considered to be essential controlled factors e.g. concentration of substrate, length of time of submersion etc.

The biggest confusion for the candidates is between validity, accuracy and reliability. Whilst at GCSE level a general reference to the number of replicates linked to reliability would suffice, at AS level it is expected candidates give a more critical assessment of the replicated results obtained. A simple range calculation is not enough for both marks when assessing reliability; rather a look at the degree of clustering and a reference of this to the extent of reliability is required. A further comment referencing the need or not for further replication based on their assessment should be given.

Validity issues should reference areas of possible error or factors which may not be totally controlled which could affect the results obtained.

Chief Examiner's Report

A2 Assessment Units

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 candidates continue to develop these skills to a high level, so that achieving success at A2 attests to a candidate's ability to apply their knowledge in unfamiliar situations and to bring together their 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 are very novel. This suggests that they have read widely around the course so that they are used to processing biological information effectively and are not relying solely upon their experience with past paper mark schemes.

Assessment Unit A2 1 Physiology and Ecosystems

This was a demanding paper and covered all of the assessment objectives. Candidates were required to recall biological knowledge and to apply their knowledge and understanding in the analysis and evaluation of a variety of stimulus material. Candidates were also tested on their ability to communicate their biological knowledge and understanding of biological principles by selecting, organising and logically sequencing information in a continuous prose question.

The questions were written and structured in such a way that allowed differentiation amongst candidates of varying ability.

Q1 This question was a relatively accessible first question on the paper and was generally well answered.

Q2 **(a)** Only a minority of candidates successfully explained the term 'biotic potential', with many others instead giving explanations referencing the maximum number of individuals which a habitat could support, i.e. confusing biotic potential with carrying capacity.

(b) **(i)** Many candidates gave good responses. Most were able to describe that when cultured together, *Paramecium* species B continued to increase in number while species A decreased in number to the point of exclusion. Stronger candidates elaborated by explaining that when cultured together, *Paramecium* species A experienced competitive exclusion i.e. it was out-competed for food (bacteria) by species B. Too many candidates referred vaguely to "competition for resources" and were penalised for doing so.

(ii) This proved more difficult for many. This part required candidates to extract relevant information which had been presented earlier in the question (that *Paramecium* is a mobile organism). Many candidates

thought that it would be difficult to distinguish between the bacteria and the *Paramecium*, demonstrating a lack of awareness of the size difference between prokaryotic and eukaryotic cells. Others considered the potentially large numbers of *Paramecium* to be the problem, when of course a dilution could be made if this was the case.

(c) Many candidates were able to correctly explain why the numbers of protoctistans would rise during the spring, most choosing to do so with reference to increasing light or temperature. However, many of these then went on to state incorrectly that these factors would begin to fall in mid to late summer, when in fact they would be expected to be at least as high as in spring. Furthermore, many candidates referred to "resources" being plentiful or limited to explain the J-shaped growth curve. Candidates must learn to give appropriate examples of these "resources" and thereby provide clarification in their answers.

Q3 **(a)** This question dealing with interpretation of data was well handled by many candidates.

(i) Most were able to describe the results shown in the scatter graph, although a minority did make the error of stating that the concentration of P_{730} levelled off in May. A significant proportion was also able to explain the changes in terms of the conversions between the two forms of phytochrome.

(ii) Part (ii) posed more of a problem, with many suggesting that the weather would affect the concentration of P_{730}.

(b) **(i)** Only a minority of candidates correctly identified the growth substance as gibberellin, as evidenced by the elongated internodal regions shown in the diagram of the plant after the addition of the growth substance.

(ii) However, it was still possible for candidates to achieve two marks in Question 3(b)(ii), since the mode of action of the cytokinin was required, with no penalty for referring to auxin (since these candidates would have been penalised already for the error, in (i)). While most candidates explained correctly that cytokinin promotes cell division, fewer candidates then made the link that there were therefore more cells available for gibberellin to elongate. Therefore gibberellin produces greatest growth when cytokinin levels, and therefore new cell availability, were not limiting.

Q4 In answering this question, many candidates demonstrated skills in making observations from photographs and using their knowledge of biological processes to explain these observations.

(a) Parts (a)(i)–(iii) were generally well answered, with a variety of explanations given for the low biodiversity of the forest. However, some candidates, perhaps meaning to suggest that the needles on these trees do not decompose easily or only provide food for a limited number of species, instead stated that the trees had no leaves. Candidates must remember the importance of communicating their ideas clearly in their responses.

(b) Parts (b)(i) and (ii) were also well answered in general. Part (iii) proved more discriminating, with the full range of marks awarded. While many candidates were able to describe the early and late stages of the secondary succession, fewer included details of the stages in between which led to the development

of the climax community. Very few candidates referred to shading of the forest floor when the new trees develop during the secondary succession, nor the consequent reduction in species diversity on the ground layer. In addition, some candidates simply described a primary succession, complete with the development of a soil. This was despite having correctly identified the succession as a secondary succession in Part (b)(ii).

Q5 **(a)** While many candidates correctly identified that the basement membrane acts as the effective filter in ultrafiltration, a minority demonstrated that they were unaware of the precise location of this membrane, by writing "the basement membrane of the Bowman's capsule". This is incorrect; the effective filter is the basement membrane of the squamous endothelium of the glomerular capillaries.

(b) **(i)** This part required interpretation of the relative concentrations of various solutes expressed as a filtrate/plasma (F/P) ratio. The question was generally well answered by most candidates. Glucose, amino acids and urea are all small enough molecules (<68 000 RMM) to be filtered equally. Most proteins are too large to pass through the basement membrane of the glomerular capillary endothelium. Stronger candidates provided further elaboration that fewer medium-sized proteins were filtered than small proteins. Some candidates attempted to answer this question from a relative reabsorption perspective and consequently were often confused in their interpretation.

(ii) The mechanism of glucose reabsorption, and the adaptations of the cuboidal epithelium of the proximal convoluted tubule that facilitate this reabsorption, was well understood by the vast majority of candidates.

(c) **(i)** Most candidates correctly identified the aquaporin protein in (c)(i); more difficulty arose with identifying the ADH receptor molecule. A glycoprotein was labelled in the diagram to indicate the exterior side of the membrane, thus assisting candidates in identifying the position of the receptor.

(ii) This question concerning osmoregulation when there is a more negative blood solute potential was well answered by some candidates.

However, a considerable number of candidates completely misinterpreted a negative solute potential to mean that there was a high water potential in the blood! Consequently their entire reasoning thereafter was completely wrong for the scenario posed in the question.

Q6 **(a)** This appeared a straightforward question, but a significant number of candidates did not explain the nature of oxidation; they merely gave an example from the diagram, e.g. the conversion of nitrite to nitrate. Others correctly stated that gain of oxygen was involved, but then lost the mark by referring to the conversion of atmospheric nitrogen to nitrate (i.e. nitrogen fixation).

(b) **(i)** 'Mutualistic association' was well understood by the vast majority of candidates.

(ii) The real issue here for many candidates was 'cause and effect'. Far too many candidates wrongly considered that longer nodules resulted in lower soil nitrogen content. It is the opposite relationship that is true.

(iii) This question was not well answered. Many candidates attempted to answer the question re factors to be considered in the experimental design to ensure valid results in terms of 'controlled variables' e.g. soil temperature and soil oxygen content.

Q7 Parts (a), (b) and (c)(i) were generally well answered.

(c) **(ii)** Many candidates did not understand how killer T-cells function. Too many candidates wrongly considered that killer T-cells attach to the pathogen and secrete perforin to 'punch holes in' the pathogen, rather than into the infected cell.

Killer T-cells have complementary receptors to, and can therefore attach to, the foreign antigens presented on the surface of a host cell infected with *M. leprae*. The killer T-cells then secrete cellulotoxic perforin which lyses the cell membrane of the infected cell.

(d) **(i)** There was much confusion among the candidates as to which method of immunosuppression affected what aspect of the cell-mediated immune response.

(ii) This question part required candidates to explain why the **level** of immunosuppression used in transplant patients must be carefully balanced. The majority of candidates understood that high levels of immunosuppression reduced the risk of transplant rejection, but increased the risk of infection. Conversely, low levels of immunosuppression increased the risk of transplant rejection. Some candidates tried to answer this question without referring to the **level** of immunosuppression and were penalised accordingly.

Q8 **(a)** **(i)** This question proved differentiating between the candidates. Many bizarre angles of arrow were drawn by the candidates to indicate the direction of light entering the retina. The arrow should have pointed up the page.

(ii) Only some candidates understood that the mitochondria found in rod cells provide ATP (not 'energy') for synthesis of rhodopsin. This was surprising given that this question has been asked before on previous examination papers.

(b) Even though the term "transduction" was explained in the question stem (b), some candidates still struggled to apply this information in suggesting a definition for phototransduction in rod cells. It is simply the conversion of light energy into electrical energy.

(c) **(i)** Candidates coped well with this question part, testing understanding of the nature of inhibitory synapses. While many correctly and effectively compared the two types of synapse, others gave responses which were not clearly communicated and contained contradictions.

(ii) The advantage of synapses in providing unidirectional impulse conduction/integration was generally well known by the candidates.

(d) **(i)** Many candidates misinterpreted the question by only calculating the percentage **difference** in rod sensitivity at 5 minutes and 15 minutes

after entering dark conditions, instead of calculating the percentage **change** in rod sensitivity.

The vast majority of candidates scored one mark here, awarded for the correct reading from the graph of the percentage rod sensitivity at 5 minutes and 15 minutes after entering dark conditions. However, very few candidates were then able to calculate the percentage change in rod sensitivity.

(ii) Generally well answered. Most candidates understood that rhodopsin was bleached during the period of exposure to bright light and that rod sensitivity increased with time in darkness as rhodopsin was re-synthesised.

(iii) Many candidates were unable to suggest a valid reason for the different responses between the two individuals in terms of how time in darkness influenced rod sensitivity. The most frequent correct suggestions were differences in age/number of mitochondria present in the rod cells; individual B was older/had fewer mitochondria in their rod cells and therefore took longer to resynthesise rhodopsin. The most commonly seen incorrect response involved reference to the number of rod cells. This reflected a flawed, comprehension of the graph, which illustrated rod sensitivity.

(e) This question was quite well answered. The majority of candidates realised that rods were involved as the photoreceptor in night vision. However, fewer candidates understood that the advantage of viewing objects in the night sky with eyes at a slight angle, is that the light rays are focused on the periphery of the retina, where more rods are located.

Q9 This free response question concerning sustainable farming practices that help promote soil conservation/fertility and help promote biodiversity in terrestrial habitats, was generally well attempted by most candidates.

Differentiation was achieved by the differing numbers of examples quoted and the detail provided in the candidates' answers. In addition, candidates were required to select and organise their knowledge effectively into their responses for Parts (a) and (b), ensuring their response to Part (a) focussed only on soil fertility and Part (b) on biodiversity.

One recurring problem for some candidates was discussing factors that **reduced** soil fertility/biodiversity, when the question clearly asked for sustainable farming practices that help **promote** soil fertility/biodiversity in terrestrial habitats.

Quality of written communication continues to be a skill that needs much development in some candidates. There is a genuine problem with scant regard to spelling, punctuation and grammar by some of the candidates in the sample of scripts marked. Candidates should also be reminded to pay attention to legibility of their handwriting.

Assessment Unit A2 2 Biochemistry, Genetics and Evolutionary Trends

The question paper covered all the major topics which comprise this unit, and, with regard to biochemistry, contained questions on both of the major pathways studied: photosynthesis (Question 3) and respiration (Question 8). Some of the questions provided opportunities for candidates to demonstrate their recall skills, e.g. Question 2(a) on nucleic acids and Question

4(a) on the sources of genetic variation, while others required a more detailed understanding of concepts, e.g. Question 7(b) on mutations. There were also opportunities for candidates to demonstrate their ability to assimilate new information and explain processes in terms of their understanding of biology, e.g. Question 3(b)(ii) on photosynthesis.

The question which proved most discriminating was Question 4, on natural selection and genetic populations. In addition, many candidates struggled with Question 8(b), on the ultrastructure of mitochondria.

Knowledge of statistics was assessed in two question parts on this paper, and many candidates coped well with the demands of these questions. However, it continues to be the case that a significant number struggle with the procedure for carrying out statistical tests.

Q1 This introductory question allowed many candidates to achieve marks early in the paper, through their demonstration of knowledge of the body plan and skeletal support found in animal groups (annelids and chordates). However, many struggled with Part (a)(iii) on bilateral symmetry. Interpreting sections is an important skill in biology, and while the translation of three dimensions into two is a challenging concept, it should be part of the skillset of those studying the subject at this level. In addition, many candidates found it difficult to communicate their understanding of the term 'bilateral symmetry', and gave limited responses which simply explained the concept of symmetry alone.

Q2 Part (a) and (b) were reasonably accessible questions and candidates achieved the full range of marks available. Many struggled with Part (c), often giving vague answers which did not address the very large difference in length between DNA and RNA. In addition, some considered the value for DNA to represent all the DNA in one cell; however, if this had been the case, then the values for mRNA and tRNA would have been expected to be much larger than those shown in the table.

Q3 Parts (a) and (b)(i) were very well answered by the majority of candidates. It was also pleasing to note the range of very good answers written for Part (b)(ii), which required candidates to assimilate new information about a photosynthetic pathway which was a variation on the one they would be more familiar with. It is to their credit that many candidates did this very effectively, often writing succinct responses which demonstrated that they had fully understood the value of this type of photosynthesis to desert plants.

Parts (c)(i) and (ii) proved more challenging, with very few achieving the mark for (i) in particular. A significant number thought that other cell contents would block the light from reaching the chloroplasts, without considering the more detailed idea of electrons being released from other organelles (notably mitochondria) in ground-up leaf tissue. In addition, many failed to grasp what was required in Part (ii), despite the question being clear that the results from all three tubes should be used to explain fully the result for tube B. A common misconception was that the blue/green colour represented a limited amount of reduction of DCPIP. The result in tube B was a colour change from blue/green to green; a significant number of candidates dwelt upon the presence of the green colour, rather than the decolouration of DCPIP.

Q4 **(a)** This was well answered by a significant number of candidates, with many achieving all three marks available. However, many others were not able to identify any processes which contributed to variation, and some gave insufficiently detailed responses, such as "(prophase I of) meiosis".

(b) **(i)** Only a minority of candidates were able to explain the term 'population' as it was used in the passage. The majority gave a definition of an ecological population, rather than a genetic

population. The essential idea of breeding was missing from most responses.

(ii) Candidates achieved the full range of marks available. This type of question, on natural selection, has appeared more than once in previous series and there seems to be an improvement in the ability of candidates to apply the steps in the process of selection to the specific situation described in the question. Some candidates lost marks through a lack of detail or inaccuracy, e.g. by stating that the enzyme, rather than the allele, was passed on to offspring.

Q5 **(a)** Question 5(a) required candidates to identify trends from graphical data, and many were adept at this.

(b) While most scored well in Part (i) and (ii), (iii) proved more discriminating with perhaps only half of the candidature achieving the two marks available. Some responses here demonstrated a distinct lack of understanding of the use of experimental procedures, with suggestions ranging from breeding experiments (between three different species) to the use of gene probes.

Q6 **(a)** It is perhaps encouraging to note that, in this question, candidates were often able to correctly describe epistasis (in contrast to responses when this was asked in a previous series). However, candidates often failed to correctly describe dominance in a way which distinguished between the two terms. Often, they referred to the expression of the dominant allele in the phenotype of a heterozygote and while this is true, it does not allow a distinction to be made with epistasis.

(b) Part (b) constituted a novel type of genetics question, in that both the genotypes of the parent plants and the phenotypic ratios produced in the offspring were given in the question stem, so that candidates were being assessed on their ability to follow through a genetic cross using the correct conventions and to correctly match the offspring genotypes to phenotypes. While many achieved the full five marks available, a significant minority failed to assign phenotypes to genotypes in their genetic diagram, and thus lost three of the marks available.

(c) Part (c) proved discriminating in that some candidates were unable to determine correctly the expected phenotypic numbers. In addition, some lost marks needlessly through the incorrect use of < or > in their determination of probability.

Q7 This question proved discriminating in all parts.

(a) Part (a) was not well answered by the majority; some failed to use the correct terminology (e.g. references to concentration of water molecules, rather than water potential) and others concentrated on the development of the thick mucus in the lungs of those with cystic fibrosis (CF), rather than the maintenance of normal mucus.

(b) In order to answer Part (b), candidates had to extract some information from a passage on CF mutations and augment this with their own knowledge on mutations and their effects. Common errors here included stating that the deletion of three bases would lead to increased severity of CF, compared with the deletion of just one base (thus failing to understand the nature of a frameshift mutation) and failing to recognise the link between mutations and protein structure.

(c) A minority achieved the full three marks available, with common errors including using 1/2500 as q (rather than q^2) and/or failing to convert the calculated value for 2pq (the heterozygous frequency) into a percentage (as required by the question).

(d) **(i)** Candidates were required to elaborate on the information which had been given in the question stem to explain some specific advantages of using GM crops. Many candidates did not add anything more to what had been given, but a significant number were able to achieve some marks here. Most often, this was for linking the use of GM crops to reduced use of pesticides, but a range of responses was rewarded here.

(ii) The context of Part (ii), as detailed in the question stem, was the ban on the use of GM crops in many European countries and significant public opposition. For this reason, vague answers such as 'it is against their religion' and 'it is unnatural' were not rewarded here. Instead, candidates should be encouraged to discuss the potential effects of GM crops on the environment/health/economy, since these are more likely to form the justification for a ban on GM crops.

Q8 **(a)** While the process of respiration has been examined before as an essay, Question 8(a) on this paper was novel in two ways: firstly, all of the reactants and products which were to be discussed were named in the diagram accompanying the question stem, and secondly, only those stages taking place in the mitochondrion were to be discussed. Unfortunately, many candidates wasted time writing a detailed account of glycolysis, none of which could be rewarded with marks. In addition, marks were only awarded when candidates demonstrated that they fully understood the role of each component in the process, since there were no marks available for naming the components. For these reasons, this was a more discriminating essay question than candidates might have first thought and simply recalling a previous mark scheme would not have been sufficient to achieve full marks.

(b) Part (b) also proved discriminating, in that there was a synoptic element involving the ultrastructure of mitochondria. A somewhat surprising number of candidates demonstrated again a lack of understanding of the uses (and limitations) of practical techniques, erroneously stating that the electron microscope could provide information on the use of the reactants of respiration, or that it could be used to 'watch' mitochondria respiring. Some candidates did give good answers here, but very few achieved the full four marks available.

Principal Moderator's Report

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

The main issue for concern amongst the moderation team remains the amount of guidance being given to the candidates. It has been found that candidate responses across several teaching groups are very similar in their wording and are also very similar to the centre based mark schemes provided by the centre.

Whilst the standard appears to have improved, it is obvious that candidates are being specifically prepared to the exact investigation which they are carrying out.

A1 Develop a Hypothesis

This is generally well dealt with by the candidates, with more concise relevant biological knowledge being given. Again, the standard should be high, with any errors in biology being penalised. The hypothesis should be a concise statement, with a direction being given where possible, and it should be distinguishable from the prediction given in A2.5.

A2 Plan a Procedure

Plans should be written prior to completion of the practical and, if needs be, they can be modified to a standard procedure to be followed by the whole class to enable replicated data to be collected. As with AS, controlled variables should contain the important factors and not just be based on the number given.

A3 Planning for Analysis

The main issue in this section is a full justification of the statistical test chosen for analysis based on the nature of the data being measured being given in A3.3. Also, numbers should be given regarding how many replicates the candidate plans to gather, whether personally or by pooling together class results.

B1-B2 Recording and Communicating

The problems which exist here are common to those in the AS report, although there is an improvement in the standard of the tables produced at A2 level. As with AS, it is important it is the candidate's own results which are tabulated and assessed. There should be no combination of marks from own results table and class results tables.

C1 Analysis

The completion of statistical analysis tends to be of a high standard with most issues occurring regarding graphical analysis. The table of statistical parameters should be clearly identifiable, even if it is not delineated by lines, and should contain the standard deviation of the mean (standard error). Errors in graphs are similar to those found at AS, as well as inaccurate plotting of confidence limits. Captions should include reference to confidence limits.

C2 Interpretation

This section can be repetitive regarding the explanation of the trend using biological knowledge. However, it is important that if the results suggest something different to that predicted then an attempt to explain this should be given. A common issue is the treatment of C2.1 and C2.2. A general statement regarding width of confidence limits and replication is not enough to satisfy both marks nor is a reference to the number of replicates being enough to make the results reliable.

C2.1 should refer directly to the reliability of the results obtained whether it is a discussion of width of confidence limits or the size of the standard deviation and for C2.2 some indication as to the need or not for further replication should be decided. Candidates who assess their results to be reliable but say they should be repeated to improve reliability should be penalised in C2.2.

C3 Evaluation

This section has improved with many centres taking on board what is expected from the moderator's reports and the agreement trials. Many of the issues here are similar to those experienced at AS level especially controlled variables and validity issues. The suggested independent variable for further investigation should be similar in nature to the investigation just undertaken and a reference to a prediction or possible outcome should be given. There is no need to provide a method in this skill area.

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