Rewarding Learning

CCEA GCE - Biology
Summer Series 2016

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 2016 provided further evidence of the high quality learning and teaching taking place in centres taking CCEA 'A' level Biology. This report will provide detailed information on how candidates performed in each paper, information that will be useful to teachers/lecturers and candidates preparing for future examinations in this subject.

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

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

Online marking was introduced to GCE Biology, both at AS and A2, this year. While this change should not affect candidates unduly, it is important to emphasise that they complete graphs, drawings, block diagrams and similar answers in black pen so that their work can be clearly seen by examiners following scanning.

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 provided good coverage of the specification and proved accessible for a wide range of ability levels. There was evidence that candidates, in general, clearly understood what was expected in answering each question and it also appeared that candidates had sufficient time to complete the paper. The paper contained a variety of stimulus material, including a photomicrograph, diagrams, tabular results and prose, and as always, candidates coped well with this.

While some questions were reasonably challenging at this level, for example Question 3(c)(ii), Question 6(b), Question 7(b), others were very accessible, for example Question 1, Question 2(a) and Question 8. Hence the paper proved discriminating across a range of ability levels.

It is particularly encouraging to note that many candidates performed well in several of the questions involving application of knowledge in novel situations, for example, Question 4 and Question 5(b).

Q1 While this was a reasonably straightforward first question, answering correctly required candidates to know both the function and the appearance of cell organelles. While a majority achieved at least four marks in this question, some did fail to correctly match organelle to function.

Q2 This question on amino acids and peptides was quite discriminating. While most candidates were able to successfully identify that A and B represented condensation and hydrolysis respectively in (a)(i), in (iii) only a minority were able to give the term 'dipeptide' for the product of reaction A. Most incorrectly referred to the product as a polypeptide. In (b), many candidates were able to access a mark, since a variety of responses were accepted for the role of R-groups on amino acids. However, candidates did need to provide a certain level of detail, and vague responses, such as 'determining shape' were not accepted. As an example of the importance of communicating understanding effectively, candidates should be aware that the use of key terms alone is often insufficient at this level, and they must include enough detail in their responses to fully answer the question. For example, a candidate stating that 'R-groups *could contribute to the formation of the shape of* the active site on an enzyme' would have gained credit, while a candidate stating that the 'R-groups could *be* the active site' would not.

Q3 This question assessing drawing skills and the understanding of practical procedures was quite discriminating. In (a), it remains the case that there is wide variation in drawing skills across the candidature, but on the whole there is a good understanding of what constitutes a block diagram and a sizeable proportion of the drawings seen were good, and correctly followed the conventions for drawing and labelling of biological specimens. Where candidates most often lost marks was in failing to show the boundaries of each tissue layer in the leaf, as seen in the micrograph. For example, it is clear in the photograph that the spongy mesophyll layer does not extend into the midrib of the leaf. Candidates should also be reminded that it is necessary to draw the specimen as it is seen and that inclusion of cell detail renders the drawing something other than a block diagram. In too many responses, a standard diagram of a cross-section of a leaf, as found in any biology textbook, was presented as a block diagram of the specimen in the photograph. This type of drawing, complete with individual cells drawn, takes valuable time to draw and is most often awarded 0 marks for drawing skills. The calculation of magnification was generally very well done, and (c)(i) was also quite accessible, although with a need for the inclusion of relevant detail on the advantage to a plant of having palisade cells tightly packed together. However, (c)(ii) was not well answered by the majority of candidates. Many, perhaps recalling previous questions on thin sections of cells cut for the electron microscope, discussed the angle at which the leaf had been cut. Others tried to suggest that it might be an adaptation of sorts to low light conditions. Very few appreciated that it was likely to be related to the preparation of the leaf, cells having been lost or damaged during the sectioning process.

Q4 (a) was generally well answered, although a significant number of candidates were not able to use the term 'conjugated protein' correctly. Part (b)(i) was also well answered and (b)(ii) was an excellent discriminator, while remaining accessible, whereby the majority of candidates were able to achieve at least one mark for drawing out the relationship from the data. Those who had correctly understood the life cycle of the Ebola virus from the diagram on the previous page were able to go further and explain the relationship effectively and precisely. It is encouraging to note that AS-level candidates did not, on the whole, struggle with applying their knowledge of viruses to this novel and contemporary situation.

Q5 This question on the cell cycle was another good discriminator, allowing candidates of differing ability levels to gain marks. Part (a)(i) was answered correctly by the majority of candidates, but many struggled with (a)(ii) and even more so with (iii), despite these being straightforward recall questions. Only a minority of candidates appreciated that there were no centrioles in plant cells, and some who did know went on to negate their creditworthy response by incorrectly stating that no spindle fibres were formed in plant cells. Part (b) represented a novel calculation type and candidates showed little difficulty in calculating the time spent in metaphase by the cells.

Q6 This question on carbohydrates assessed a range of skills, including recall of the functions of carbohydrates and of practical procedures, and application of knowledge in an unfamiliar context. As such, a wide range of marks was achieved in this question. In (a), the identification of sucrose (D) and deoxyribose (E) proved the most challenging. In (b), a simple restating of ideas presented in the question stem was not sufficient for credit, (for example glycogen is more easily broken down than lipids). Instead, it was necessary to go further and explain that glycogen would allow for a more rapid release of energy than would lipids. Very few candidates were able to extrapolate the idea that lipids stored more energy per unit mass, to conclude that their use helped keep an animal's body relatively light. Answering Part (c) required a knowledge of how to hydrolyse sucrose using acid hydrolysis, as well as how to carry out the Benedict's test for reducing sugars. At this level, it is important that candidates are aware of the need for detail in descriptions of practical procedures, particularly those which they would be expected to have some experience of at GCSE level. Hence, omitting any reference to a boiling water bath for the Benedict's test and/or failing to describe the colour change would represent a disappointing lack of familiarity with the test. As in some previous series, there was also a requirement to explain a suitable safety precaution, and it should be borne in mind here that sufficient detail and justification should be included in responses to indicate that the candidate has risk-assessed the procedure in question. In this instance, safety precautions relating to hot water/hot acid/glassware were appropriate. Candidates should be strongly discouraged from giving generic safety advice, without qualification, in questions such as this.

Q7 In the penultimate question, candidates should expect to answer structured questions around a theme, which in this case was osmosis and water relations in cells. Part (a) was relatively straightforward, but many candidates failed to note that both parts of (a) (i) were to be answered in reference to a plant cell at the point of incipient plasmolysis. Such responses interpreted the term 'relationship' as referring to a trend, and described how water potential changed as solute potential changed (or vice versa, confusingly), when in fact at incipient plasmolysis they are of course equal to each other. Part (b) required careful reading to understand the nature of the experiment carried out, and a significant proportion of the candidature struggled to predict how the dandelion strip might change in 10% sucrose solution. In Part (ii), some candidates displayed a common misunderstanding when dealing with questions of this type, in that they described the movement of water into 'the cell'. It is important that candidates appreciate the distinction between cells, tissues and organs, and that a piece of dandelion stalk (or a potato cylinder, etc.) contains many millions of cells. Furthermore, it was necessary to appreciate the differential curvature which would result from the uptake of water by cells on the inside and outside of the stalk. In (c) and (d), candidates were required to apply their understanding of osmosis to other types of cell, and a majority coped well with the demands of this question, although only the most able gave the detail required to achieve full marks in both questions.

Q8 This question on enzymes and immobilisation technique divided candidates, since many knew the topic to a high level of detail and were able to score accordingly, while others had only a superficial knowledge of enzyme immobilisation, where most marks were to be gained and hence did not perform well in this question. This underlines the need for a thorough knowledge and understanding of all parts of the course for those who are seeking a top grade in this subject. In Part (a), candidates were required to explain in sufficient detail the relationship shown by the graph, between rate of reaction and enzyme concentration. Relatively common omissions here included reference to increased active site availability, increased rate of enzyme-substrate complex formation and noting that eventually substrate availability will become the limiting factor in the process. In Part (b), it was clear that many candidates had a clear understanding of the differences between each method of immobilisation. Some common errors included confusion

between entrapment and encapsulation, and a failure to adequately describe the method of immobilisation. With regard to advantages and disadvantages of the technique, many again had a good knowledge and understanding of the topic. Some vague answers such as 'the enzyme can be reused' or 'the enzyme is specific' were not rewarded, since they were often describing properties of all enzymes, whether free or immobilised.

Assessment Unit AS 2: Organisms and Biodiversity

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

Many candidates lost marks due to their inability to express and communicate their biological knowledge clearly and unambiguously, and there was evidence that some candidates did not read the questions carefully enough even though many trigger words were in bold and the language was straightforward throughout.

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

Q1 This question on classification proved to be more demanding than anticipated. This was surprising as each of the question parts involved recall of knowledge only. Part (a) was generally well known but Parts (b) and (c) were often not well done. Part (b) asked candidates to identify the taxonomic rank which consists of a group of genera. A significant number of candidates incorrectly answered species. Part (c) was also poorly answered; credit was given for those candidates who were unable to spell phylogenetic accurately but who could produce an answer that was broadly phonetically correct.

Q2 This question on gas exchange in plants and animals resulted in a wide spread of marks across the candidature. A very small minority of candidates got full marks. In Part (a) candidates were expected to state one difference between gas exchange in animals and plants and then to describe one way in which a diffusion gradient is maintained in the mammalian lungs. In (a)(i) a surprisingly large number of candidates made reference to plants only respiring or releasing carbon dioxide at night. Many candidates obtained the mark for Part (ii) either by referring to the blood removing oxygen from the lungs (or carrying blood rich in carbon dioxide back to the lungs) or by describing the role of ventilation in bring in oxygen-rich air (or removing air with high levels of carbon dioxide). Part (b) was based on the use of bicarbonate indicator to study gas exchange in living organisms. A surprisingly high number of candidates failed to get the colour change correct in the first of three parts. Part (ii) was usually well answered with a significant number of candidates appreciating that in full light the rate of photosynthesis would exceed the rate of respiration and consequently there would be a reduction of carbon dioxide in the boiling tube. A significant minority mixed up the gases taken in and produced in respiration and photosynthesis. Part (c) asked candidates to extend the investigation described in (b) to demonstrate the compensation point in the pondweed. Most candidates were aware that the compensation point involved reducing light levels (compared to Tube B) and that this could be achieved by the use of muslin or by moving the position of the lamp. However, a majority of candidates assumed that one change of the lamp position or a layer of muslin would automatically produce the compensation point. Only the more able candidates commented that it is important to **adjust** light levels and record indicator colour **until** the compensation point was reached. A majority of candidates were aware that at the compensation point the indicator would remain red (or not change colour). Only a small minority of candidates gave a controlled variable that would be important in this investigation.

Q3 This question on applied seashore ecology also produced a wide range of marks. Part (a) used lichen growth on rocks as a novel setting and required candidates to deduce answers from the information provided. Most candidates made a good attempt and deserve credit for logical and creative thinking. Part (i) was well done and many candidates appreciated that a vertical rock face habitat would not suffer disturbance from trampling or that the lichens would not be outcompeted by other plants (growing on the rock). Part (ii) was usually well answered with many candidates answering space as the main resource the lichens were competing for; a small number assumed it was light. Part (iii) was often well answered with candidates appreciating that if lichens "grow very close to the rock surface" then it would be unlikely that one particular lichen would extend into an area already colonised by another one. Part (b) on xerophytic adaptations was well done. In (b)(i) a majority of candidates answered that the samphire had either succulent leaves or leaves that were long and thin or had a small surface area. Some candidates lost the mark through not reading the question carefully enough and then going on to state that samphire had leaf hairs or sunken stomata or another feature that couldn't be seen in the photograph. These answers were not credited as they did not answer the question correctly as asked. Part (ii) was very well answered with sunken stomata being the most common correct answer.

Q4 This question was generally well answered. Part (a) was a three-mark question requiring candidates to explain lysotrophic nutrition. Many candidates picked up at least two of the marks available. Good use of terminology was common by the more able candidates but others lost at least one mark through producing answers that lacked detail. In part (b) the theme was selection and evolution in the Fly Agaric. In Part (i), a significant majority of candidates were able to state that toxin in the cap would help protect against herbivores eating the cap. Only a minority developed this to explain that if the cap was protected the fungus would be able to reproduce. Part (ii) was very well answered. Many candidates produced high quality answers that were well sequenced. Most candidates picked up one mark in Part (c) but only a very small minority obtained both. Most candidates were able to describe a difficulty in measuring fungal length, for example microscopic hyphae, difficulty in excavating soil without damaging hyphae, but then failed to extend their answer to indicate that this would make it difficult or impossible to know where one individual stopped or another one started.

Q5 The cardiac cycle was the topic tested in question five. The first few sections were relatively straightforward testing both knowledge and understanding. Part (c) was much more applied. It is pleasing to report that many candidates showed good understanding and were able to answer the applied sections well. Surprisingly, a significant number of candidates answered 0.9 seconds (rather than the correct answer 0.8) for (a)(i). Parts (a)(ii) and (iii) were generally well answered, although vague answers were not uncommon in Part (iii). Answers that failed to gain credit in this part included semi-lunar valves (without further detail), valves shutting, semi-lunar valves opening and closing and a number of answers referring to the AV valves. Part (iv) proved to be more demanding with only a minority of candidates really understanding why the pressure decreased in the atria at position Y in the diagram. Many candidates described blood flow between the atria and ventricle, an incorrect answer that failed to gain credit. Part (b) was expected to have been straightforward. In reality, while a majority of candidates obtained one of the two marks available, only a minority achieved both. Some candidates simply mixed up the aorta and the pulmonary artery but the most common error was that while candidates understood that the aorta had a thicker wall, they assumed this was because the aorta had further to **pump** the blood. Part (c) required candidates to interpret information on the differences in the foetal circulation. Part (c)(i) required candidates to suggest why blood moves directly from the right atrium to the left ventricle in the foetus. This was generally well answered and many candidates were able to suggest that this was due to the lungs not being developed or that oxygen is obtained from the placenta **and**

therefore the lungs need to be bypassed. Some candidates lost marks through very poor expression, even though there was some evidence that they seemed to show at least some understanding. Part (ii) proved to be more demanding with often only the more able candidates scoring both marks. A minority of candidates mixed up the left and the right sides of the heart and others linked the reduced oxygen in the organs to the developing heart's reduced ability to pump blood around the body. Some assumed there would be less blood travelling around the body; there was often confusion as to whether there was **less** (oxygenated) **blood** or **less-oxygenated** blood travelling round the body.

Q6 This question tested candidates' understanding of water transport in plants. Part (a) focused on the transport of water into the xylem, Part (b) then focused on xylem structure and the link between transpiration rate and xylem vessel diameter. Part (a) was usually well done although a significant number of candidates mixed up apoplast and symplast in Part (i). In (ii), the endodermis was usually answered correctly although there were many vague attempts, producing answers such as, epithelium, epidermis, endothelium or endoderm. Part (iii) was also usually well done, with many candidates able to accurately describe the function of the Casparian strip. Part (b)(i) asked candidates to describe and explain one way in which xylem vessels are adapted for their function. Most answers focused on either the strengthening or waterproofing role of lignin and this was normally well done. Part (b)(ii) proved much more problematic for many candidates. This question part required candidates to interpret a graph showing how transpiration rate and xylem vessel diameter were related. Top candidates answered the question well with detailed accounts that showed good sequencing. Those candidates who misinterpreted the relationship, i.e. that diameter of the xylem vessels **causes** the change in transpiration rate usually failed to pick up any marks. Consequently, this question part proved to be an excellent discriminator in a question that was otherwise well done.

Q7 This question on plant ecology tested a wide range of skills, including mathematical and graph drawing skills. Answers for (a)(i) were usually either correct (linked to the different flowering periods of the orchids) or suggested it was to increase reliability (an answer that failed to gain credit). A significant minority were unable to calculate the value for D in Part (ii). Many candidates were able to link the presence of the 'rare' Bird's-nest orchid to the designation of the ASSI for the deciduous wood – in this question, reference to the 'not common' lesser twayblade was treated as neutral but listing of other 'common' species was penalised. Part (a)(iv) produced a mixed response. Many candidates understood that the D value would increase, but then went on to contradict (and disqualify) this by suggesting that biodiversity would increase. Often the second mark was lost due to general references to overall biodiversity rather than focusing on the orchids as required. Part (b)(i) was a four-mark graph. Generally, the graph was very well done. Axes and axes labels were usually good as was the drawing of the bars. Most candidates understood that there should be a gap between the bars for the different species. The mark that failed to be awarded most often was the caption mark and this was usually because candidates failed to make it clear that the data included both different species of orchid **and** the numbers of plants for each species. A significant minority of the candidature attempted to draw a line graph; these candidates were able to pick up the caption mark and the axes mark if these were done correctly. Part (b)(ii) was answered correctly by most candidates.

Q8 Section B (the essay) was an effective discriminator, perhaps providing a wider range of marks than expected. Nonetheless, many candidates scored maximum marks, produced outstanding accounts showing excellent understanding of all that was asked. In Part (a) a significant number of candidates drifted off the focus of the question (haemoglobin) and then spent considerable time discussing the adaptations of red blood cells; not surprisingly these candidates scored poorly in this part. The first few marking points in (a) were usually well done – candidates describing haemoglobin as being a conjugated

protein, with a haem prosthetic group containing iron. Most candidates could state that haemoglobin usually carried four oxygen molecules and there were some excellent accounts of cooperative loading. A smaller number of candidates referred to oxygen being loaded in the lungs by haemoglobin where partial pressures of oxygen were high and dissociation taking place in the tissues where the partial pressure was lower. AS terminology was required (for example reference to high partial pressures of oxygen) and GCSE standard accounts were not rewarded. Many fewer candidates were able to describe the significance of the S-shaped dissociation curve for haemoglobin. Part (b) required candidates to describe and explain how haemoglobin is able to maximise the delivery and release of oxygen during both strenuous exercise and at high altitudes. A minority of candidates lost marks by not making it clear whether they were describing the response to exercise or high altitude. It was important to do this in this section as the physiological response of haemoglobin is different in each situation. Those candidates who were clear in their understanding of how haemoglobin responds to the **low oxygen levels in the tissues** associated with strenuous exercise or the **low oxygen levels in the atmosphere** associated with high altitude tended to produce excellent accounts.

Principal Moderator's Report

Assessment Unit AS 3 Assessment of Practical Skills in AS Biology

Coursework submitted by most centres continues to be of a high standard and the centres new to CCEA showed a good understanding of what was expected for each of the marking criteria and marking by the centres showed good agreement with the moderation team. As with previous years the majority of practicals come from determination of water potential, enzyme investigations and membrane permeability. It is good to see ecological investigations still being submitted. Moderation was aided by the inclusion of centre based mark schemes and clear teacher annotation as to where marks are awarded or deducted greatly helped the moderation process. Internal moderation is also becoming more evident although care must be taken that the changes made by internal moderation are changed on the pupil's work and the eCRS.

It is important that the coursework being submitted is suitable for AS and that the CCEA guidelines sent to schools be strictly adhered to. It was also good that the new eCRS system greatly reduced the number of computational errors which would have occurred in the past. However, there were still some errors in marks recorded on the eCRS and marks awarded on pupil's scripts.

Implementation

Many centres included a risk assessment to illustrate they had carried out the work safely. Teacher annotation was clear to verify this had occurred. Again if errors were made in recording of the data or differences in the degree of precision (for example different decimal places) then this should be penalised.

Recording

This was an area where there were many differences between moderator and centre marking. These differences included incorrect units or units in body of the table and captions for tables, especially when transmission or absorbance was being measured. Temperature does not affect light transmission but rather it affects the leakage of pigment which is measured by transmission.

There were also some issues with the quality of the best fit lines which frequently did not bisect the points evenly.

Interpretation

The candidates showed good detailed biological knowledge of the practical tasks they were completing and marking of this section was good. However, the description of the trend was often too long and included aspects which were more relevant in section C3. It should discuss the shape/trend evident in the graph with the use of some data values to illustrate this.

As with previous years there was an issue with the determination of the water potential of plant tissues. The determination refers to the zero % change in mass at the isotonic point and not the point of incipient plasmolysis. There is no need to link pressure potential to this determination. The candidates also should have more discussion on the reason why stored sugars affect the water potential.

Evaluation

In D1 candidates should discuss the appropriateness of the measurements based on the main apparatus used. This should reference, where appropriate, the precision of the measurements for example number of decimal places or reasons of suitability for example colorimeter more sensitive etc.

The biggest issue in this section is still in D4 and D5.

Many candidates still assess variation based on a range calculations. It was evident in many cases that results with a large calculated range still only had a narrow spread of the rest of the results. It is also not sufficient to mention anomalous results only.

For D5 candidates should discuss the need or not for further replication based on their assessment of the reliability in D4. It is not sufficient to state that the results were repeated a number of times therefore they are reliable.

The aim of Section D is to critically evaluate their method and results.

Chief Examiner's Report

Assessment Units A2

General

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

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

Assessment Unit A2 1: Physiology and Ecosystems

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. Many questions parts provided an opportunity for 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 candidature as a whole.

There were very few scripts with a significant number of blank spaces and in most questions candidates attempted to respond. Most centres had clearly prepared their candidates to a good standard and there was evidence that the content of the specification had generally been well taught. However, there was evidence that candidates were less well equipped to do well in those questions involving practical work. There was very little evidence to suggest that candidates were unable to complete this paper on time.

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. Often candidates either failed to address the question entirely or only gave partial answers thereby preventing themselves from accessing all the available marks. In particular, the candidates' ability to describe trends was particularly weak in several questions.

Q1 This question involved the straightforward recall of key terms related to muscle. A majority of candidates obtained all five marks. The most common incorrect answers involved named the sliding-filament theory and answering A-Zone/H Zone instead of A-band. A number of candidates failed to appreciate that the answer was smooth muscle for the final bullet point.

Q2 This novel question covering biological control was discriminating resulting in there being a wide range of marks across the candidature. Most candidates were able to provide the definitions in (a)(i) and (ii), although some lacked the detail required at A2 level, such as not making reference to the economic impact in Part (ii). Part (b) also discriminated well. Part (c) discriminated particularly well. A significant number of candidates were penalised for not making reference to the number of pests increasing beyond the initial population (this despite a similar question being in the previous series); the detail of the pesticide killing the pest was also missed by many candidates. Part (c)(ii) was often well done.

Q3 This question tested candidates' knowledge of plant hormones and their ability in planning a practical procedure. Part (a) was straightforward recall with some candidates failing to use the required biological detail necessary to gain credit. In Part (b) a significant number of candidates failed to identify the dependant variable, many giving the independent variable instead. The four marks available for this part were easily accessed by many of the more able students.

Q4 This question tested candidates' practical skills in using a haemocytometer. Only a small minority of candidates accessed all three marks in (a)(i), showing a lack of understanding of the initial sampling aspect of using a haemocytometer. Some candidates misread the question and gave details of counting and dilution procedures. Part (a)(ii) was a standard haemocytometer calculation that candidates should be familiar with, with the twist of a dilution factor. Some candidates failed to even get one mark for counting the yeast cells, again showing lack of practical experience. A majority of candidates did get at least two marks in this section; the most common missed mark being the dilution factor. Surprisingly, Part (iii) was often poorly done with a disappointingly high number of candidates failing to appreciate that at 60°C the enzymes in the yeast would denature and consequently the population would be much lower. Some candidates who understood the principle were penalised through failing to be precise enough and stating that the cells or yeast denature, failing to state that it was the enzymes that actually did this. In part

(iv) many candidates were able to give two controlled variables; a practical skill that is usually well developed in candidates. Nonetheless, there were many who did not read the question clearly and answered time as one of their answers. Part (b) provided an element of stretch and challenge. Many candidates did get one of the two marks for appreciating that dead cells could be identified and therefore not counted; though a small number just made reference to identifying the dead cells and not how this would be applied to the calculation to make it more accurate. The explanation of how the dye would enter the cells was poorly expressed, with cell walls instead of cell membranes being referred to as selectively permeable.

Q5 This question on nervous communication also proved quite discriminating. Part (a) required candidates to identify and explain trends on the relationships between rate of transmission and axon diameter for different species and the presence or absence of myelination. Only a minority of candidates were able to provide full enough descriptions to obtain all three marks in (a)(i). Part (a)(ii) was generally well answered with most candidates being able to explain how myelination increases the rate of nervous transmission. Part (b) on neurone arrangement in the retina was well answered by a majority of candidates; a minority of candidates incorrectly focused on the iris reflex, an approach that was not rewarded and can only be explained by candidates failing to read and understand the question properly.

Q6 The nitrogen cycle was covered in question six. Part (a)(i) required candidates to recognise root nodules in a photograph and then describe their role in the recycling of nitrogen. This was generally well done although a significant minority of candidates failed to recognise the nodules and consequently struggled with this question part. Part (ii) was well answered. Part (b)(i) was well answered although some candidates lost marks through lack of detail, for example, by referring to nitrogen when nitrate was required in the answer. Part (b)(ii) was well done with the majority of candidates gaining all three marks.

Q7 This question tested candidates' ability to recognise the gross and ultrastructure of the kidney using colour photographs and, in addition, tested their understanding of osmoregulation in different environments. A majority of candidates could identify the regions of the kidney in (a)(i), with the pelvis being the region causing most difficulty. Part (a)(ii) was done well by the more able candidates but frequently mixed up by the weaker or less prepared candidates. In Part (b) the identification was well done overall; a minority of candidates mixed up the Bowman's capsule with the basement membrane. The explanation of ultrafiltration was more discriminating with lack of detail on how the pressure was created or failure to reference the basement membrane/filter role in the process often costing marks. Part (c) on osmoregulation in two contrasting environments also proved to be an effective discriminator.

Q8 Mathematical skills using standard form, analysis of tends, definitions of key terms and data analysis were all tested in this question. Part (a)(i) involving a calculation using standard form was generally very well done and a significant majority of candidates picked up both marks. Part (ii) was generally well answered, though some candidates lost marks by not linking respiratory losses to the plant or specifying cellulose as the plant component that is difficult to digest. Part (b)(i), the definition of community was well known by the majority of candidates. Many candidates found (b)(ii) more difficult through being unable to give a possible reason for the atypical pyramid of biomass. Part (b)(iii) required candidates to interpret the possible implications of a change in consumer numbers in a community. This was generally well done with many candidates obtaining all three marks available. Both questions in Part (c) required candidates to identify trends from graphs displaying novel data. These were often poorly done, a common mistake being the suggestion that change in the dependent variable shown leads to subsequent change in the independent variable.

Q9 Part (a) was well done by the majority of candidates, many achieving full marks in this section. There was a significant number of candidates who either described both B and T responses or only focused on the T response. The mark scheme allowed a maximum or four marks for the latter approach. Part (b) was less well done and marks were lost due to lack of sufficient detail and clarity in many points. Even the idea that the Rh antigen was on the red blood cells was missed by many better candidates. The quality of written communication was high in the majority of scripts with most candidates obtaining both marks. There was very little evidence of candidates having a lack of time to complete this question.

Assessment Unit A2 2 Biochemistry, Genetics and Evolutionary Trends

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

Q1 The first question this year was on plant classification and it was well done by the majority of candidates. Surprisingly, a significant minority failed to obtain the mark for (a)(i), through not being clear that the prothallus was the stage that contained haploid cells only. Part (a)(ii) was well done and most candidates were secure in their understanding that ferns are usually restricted to damp environments for a number of reasons including that the male gamete requires water to get to the female gamete and the absence of a cuticle, stomata and vascular tissue in the prothallus. Similarly, candidates were able to identify the presence of a cuticle, stomata and vascular tissue (in the sporophyte) as being adaptations to life on land that are not present in mosses (1(b)). For the further adaptation in flowering plants (compared to ferns) the reduction of the gametophyte or the transfer of the gamete by wind or insects were the most common answers. Incorrect terminology or lack of detail did cost some candidates marks in (a)(ii) and/or (b).

Q2 This question on respiration was well answered by most candidates but almost all found some parts difficult. Part (a) was well done and a significant number of candidates obtained all five marks. The main errors or omissions were failing to add oxidative before the phosphorylation (bp2), the site of the link reaction being the mitochondrial cristae (rather than the matrix (bp 3)) and failing to extend the answer of the process that produces lactate as anaerobic respiration **in animals** (bp 5); this was the most common part of the question that failed to gain credit. Part (b)(i) was well done and most candidates could calculate the RQ value for tripalmitin. In Part (ii) most candidates could link the 0.7 RQ calculated in (i) to it being typical of fat, but only a few candidates were able to pick up a second mark here. Part (c) tested the candidates understanding of the changes that take place as grape juice is fermented in a closed container. In Part (i) most candidates could appreciate that carbon dioxide levels would build up to a dangerous level if a bung was used to seal the container rather than the S-shaped capillary tube. Part (ii) discriminated well with very few candidates obtaining all three marks. Only a small number of candidates answered that as the RQ was 1 for the first hour, then the yeast was respiring carbohydrate. Most candidates could appreciate that the RQ increased due to anaerobic respiration taking place after the first hour. A good number could deduce that the RQ value further increased due to the proportion of anaerobic respiration increasing over time as oxygen levels decreased. A common answer was that respiration was initially aerobic, then aerobic and anaerobic, and finally anaerobic only. This type of answer was credited two marks and candidates were not penalised for suggesting that the

respiration became anaerobic only, even though anaerobic respiration only would have a value of infinity for RQ.

Q3 This seven-mark question on animal classification was well done. Candidates who had a detailed knowledge were able to obtain six or seven marks. Part (a) tested understanding of a transverse section through a cnidarian and was generally well done, although a minority of candidates were let down by poor terminology. In Part (ii) a small number of candidates suggested that lack of a mesoderm (or being acoelomate) was a feature that indicated the section was that of a cnidarian. This was not credited as being acoelomate also applies to other groups. The most common correct answers were being radially symmetrical and diploblastic. Part (b) proved to be the most discriminating part of this question. Many candidates scored one of the two marks but only a minority obtained both. Many candidates seemed to have a broad understanding of digestion in cnidarians, but only the more able tended to complete suitably detailed answers. Part (c) required candidates to suggest one reason why cnidarians are restricted to aquatic environments. Most correct answers focused on water being important for obtaining food or for locomotion. Many candidates referenced the cnidarian hydrostatic skeleton as requiring an aquatic environment. This was not given credit unless the hydrostatic skeleton was linked to the fluid-filled enteron; a more general reference to hydrostatic skeletons was not awarded, as annelids also have a hydroskeleton and many species in that group, for example the earthworm, are not restricted to aquatic environments.

Q4 Protein synthesis was tested in this question. Part (a) included relatively straightforward questions on transcription, whereas Part (b) was novel, requiring candidates to interpret a diagram of gene inhibition. Not surprisingly, most candidates did well in Part (a), but often less well in Part (b). Most candidates could identify strand X as the template/coding/sense strand and also Y as a ribonucleotide (Parts (a)(i) and (ii)). Part (iii) was a four–mark question on the process of transcription. This was well done by most candidates. Answers tended to be very well written and usually well sequenced. The exact role of RNA polymerase was the part least well known; a sizeable number of candidates failed to make reference to the RNA nucleotides being bonded together to make the mRNA strand. Part (b)(i) was an excellent discriminator with only a small minority of candidates obtaining all three marks. Many candidates confused the sequence of events, proposing that the attachment of the RNA polymerase caused the inhibitor to move and subsequently join with the lactose. More able candidates were able to discount this scenario and deduced that the lactose joining with the inhibitor was the initial stage in the process of switching the gene on. They then reasoned that this caused the inhibitor to become attached from the gene, thereby enabling the RNA polymerase to attach and initiate transcription. The most elusive mark proved to be the second mark; an understanding that it was the change in shape of the inhibitor (as a consequence of the lactose attaching) that caused it to be no longer complementary to the gene. Part (b)(ii) was also discriminating. Most correct answers tended to explain that if there was no lactose present then there was little point in making the enzyme.

Q5 Question five tested a range of genetic concepts and was often very well done. Part (a)(i) was a straightforward monohybrid question on fur length in a mammal. Almost all candidates could complete the cross but a significant minority failed to link phenotypes to genotypes and consequently dropped one mark. Part (ii) asked candidates to identify the possible genotype(s) of individuals with F + 15% phenotypes. This was very well done. Part (iii) was a standard dihybrid cross involving a cross between a double heterozygote and an individual heterozygous for one gene and homozygous recessive at the other gene locus. This four-mark question was well done by most candidates and it is pleasing to note that crosses tended to be clearly set out. Again, as in Part (i), the main reason for the loss of a mark was failure to link phenotypes to their respective genotypes. Part (iv) was also well done; the effect of the environment or polygenic inheritance gaining reward.

A significant minority answered multiple alleles, but as this would not give the range of phenotypes suggested by continuous variation, this answer did not gain credit. Part (b) was less well done and clearly caused difficulty for many candidates. A minority didn't seem to understand how to work out the genotypes at all, while many others understood the concept, but failed to include the full range of genotypes for one or both of the fur colours.

Q6 Question six was wide-ranging and covered photosynthesis and statistics. It required candidates to interpret a novel investigation, briefly outline a follow-up investigation, interpret graphs and then calculate and plot 95% confidence limits. As anticipated, it proved to be highly discriminating. In Part (a)(i) candidates had to explain why aerobic bacteria accumulated at a particular point on the surface of a filamentous alga. Those candidates who scored both marks in this part understood that at position B, the narrow beam of light reached the Spirogyra at the point where the spiral chloroplast was closest to the surface. Consequently, there was more photosynthesis at this point and therefore more oxygen produced causing the aerobic bacteria to accumulate. Candidates who failed to obtain both marks generally referred to the beams of light being different wavelengths and/or to the 'products' of photosynthesis, without appreciating the significance of the oxygen. Part (ii) was also discriminating; many candidates answered temperature as a controlled variable, without recognising that as the two adjacent cells were beside each other and on the same filament the temperature would be the same. Part (b) was usually well done with most candidates understanding that different wavelengths would be used to investigate the photosynthetic action spectrum and that most photosynthesis would occur when in red or blue light and less in green light. Part (c) proved to be the most demanding part of the question. Only a very small minority of candidates obtained full marks. Part (c)(i) asked candidates to provide evidence from the graphs to show that they provided data on net photosynthesis (rather than gross photosynthesis). Many candidates gave theoretical answers based on their knowledge, rather than citing evidence from the graphs; this approach gained no marks. Additionally, many candidates referred to negative values of carbon dioxide in the graph without making it clear that they understood that these values represented carbon dioxide given off; again, this was not credited. In (c)(ii), a majority of candidates understood that the graphs showed that there was more carbon dioxide taken in by the tree in midsummer (compared to midwinter) but only a small minority noted that the intake was also for a longer period of the day in midsummer. Even fewer answered that more carbon dioxide was given out during the night in midsummer. Consequently, few candidates obtained both 'description' marks in (c)(ii). Candidates were more successful in their 'explanation'; most could appreciate that if more carbon dioxide was taken in, then there was more photosynthesis in summer and that this was due to higher light intensities or higher temperatures. Smaller numbers were able to extend their explanation of the data to state that the increase in carbon dioxide given out during the night in summer was due to more respiration due to higher temperatures or more growth. Part (d) required candidates to calculate 95% confidence limits and then plot these on a partially completed graph. This was generally well done by the more able candidates, but often not so by others. Part (d)(iii) asked candidates to explain the negative correlation between leaf lifespan and soil fertility. Candidates were given credit for either of two approaches to this. They could explain that where there was low soil fertility, there weren't enough nutrients in the soil to replace leaves more often, or that if trees lost their leaves more often, decomposition of the leaves would lead to a higher soil fertility.

Q7 Gene sequencing, gene technology, gene therapy and statistics were all covered in this question. As would be expected from a question at this position in the paper it discriminated very well. Part (a) was on gene sequencing for Addison's disease. In (a)(i) candidates were asked to suggest one component of the blood from which DNA could be obtained. A surprisingly high number of candidates got this wrong, with frequent

incorrect answers including red blood cells and plasma proteins. Many candidates understood that there would be no heterozygotes in males as they have only one X chromosome (Part (ii)). Part (iii) was only well answered by a minority of candidates. Only those candidates who understood that the question required a comparison of both male and female AAD patients and their controls did well; many candidates compared heterozygote AAD females with homozygous AAD females, or males against females and so on. Part (iv) tested the candidates understanding of statistics, rather than their ability to mechanically work through a statistical test that is on the specification. Few candidates obtained both marks. Only a small number of candidates appreciated that a p value of 0.03 means that there is less than a 3% chance of the difference between the two groups being down to chance; this part was very poorly understood. Many candidates were awarded the second mark as they understood that a value of $p < 0.03$ meant that the data of the two groups was 'significantly different'. Part (b) tested understanding of gene therapy in the context of Addison's disease. Generic gene therapy disadvantages were not awarded, but many candidates picked up from the information provided that many genes were involved in AAD, that research is at an early stage (so that it is not clear as yet, what part of the genome actually needs targeted), and that the adrenal glands were not very accessible, answers that showed good comprehension skills and were credited. Most candidates had a clear understanding of what 'knockout' and 'knockin' mice were and so did well in (c)(i). Part (c)(ii) was also well done with many candidates giving at least one good answer suggesting why mice are suitable model organisms for genetic study.

Q8 Section B produced a full range of responses from the candidates. A small minority of very able candidates achieved full marks. Full marks was much more common in the short Section (b) that tested polyploidy, than in Section (a) that tested variation, selection and reproductive isolation and was worth three times as many marks. To obtain full marks in (a), candidates had to write an account that was well balanced in its coverage of variation, selection and reproductive isolation and their particular roles in speciation. Lack of balance (and therefore not potentially accessing all of the marking points) was the reason why many able candidates failed to reach the upper mark ranges. Nonetheless, there were some excellent accounts in which candidates showed a clear understanding of speciation and the respective roles of variation, selection and reproductive isolation and produced well sequenced essays. Apart from missing sections out, candidates frequently lost marks through lack of detail or failure to use appropriate 'A' level standard terminology. Many candidates were not secure in their knowledge of the link between geographical separation and reproductive isolation, in that reproductive isolation is a consequence of geographical separation, rather than something that develops well down the road to speciation (at least in allopatric speciation). Part (b) was usually well done with most candidates gaining two marks for a description of polyploidy and then usually a further one or two through producing differences between polyploidy and speciation as described in Part (a).

Principal Moderator's Report

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

Work submitted at this level continues to be at a high standard and in the majority of cases this is rigidly marked in line with the assessment criteria. There are still issues in a few areas which will be addressed below. As with previous years the majority of work comes from membrane permeability and enzyme practicals, however there are still some centres providing excellent fieldwork investigations. Attention should be drawn to students about the need for relevant background information on the factor being investigated rather than all information about a topic.

It is important that guidance given by teachers follows the JCQ guidelines and that this is general and not specific to the investigation chosen. Also if annotation is clear as to the awarding or deducting of marks, it makes it easier for the moderator to follow and thus easier to make a judgement on marking.

A1 Developing the Hypothesis

In most cases this was well tackled by the candidates and the standard of biology was excellent. It is important at A2 level that errors in biology or omitting key information should be penalised. In A1.4 the prediction should reference the units being measured for example, at higher temperatures the % transmission should decrease.

A2 Plan a Procedure

The two key areas of concern in this section are in justification of the range of the independent variable and the key variables to be controlled. Some discussion should be given to reflect the reason why the candidates have chosen their range and it is essential that candidates choose their own range. In many cases this maybe the same for some candidates but it would be expected within a centre/teaching group that there would be some variations between candidates. At the end of the planning stage the teacher can give a range that the whole class can follow. Also the plans should be written in the present (or future) tense and not the past tense.

When justifying the controlled variables it is not sufficient, as is the case at GCSE, to simply say only one variable can be changed at a time rather the reasons behind why each individual factor is controlled for example, temperature is controlled as it can affect the number of collisions between enzyme and substrate and thus affect the rate of reaction.

A3 Planning for Analysis

The main issue here is in the choice of statistic for analysis and the justification. This should reference the nature of the data and whether or not it is a range or two samples for example a graph with confidence limits will be used as we are recording % transmission which is continuous data and it is being measured over a range of values of IV.

B Implementing and Recording

Similar issues exist here as with AS level i.e. captions and lack of/wrong units. Again it is essential the candidates record their own (their group) results in a table of raw data.

C1 Analysis

Statistical analysis using a student's t-test was well carried out by the centres which chose this method. It is important that candidates state a probability value or range when interpreting their t value (this is what is expected in the examinations!) for example $0.5 > p > 0.1$

When using confidence limits it is important that there is evidence of how the confidence limits are calculated. An area of concern raised by the moderating team was the number of incorrectly plotted (or calculated) confidence limits which were not penalised. In many cases it was very obvious that the limits were not symmetrical about the mean.

C2 Interpretation

Skill areas C2.1 and C2.2 have greatly improved over the years and it is good to see many candidates having a good understanding of assessing the variation by using their statistical tests/confidence limits. However, it is not sufficient to just state that wide confidence limits equals lack of reliability. It must refer specifically to their plotted results. The comment on the reliability should then reflect the need or not for further replication.

The explanation of the trend should reference back to their hypothesis in the planning section and any other occurrences which do not match the prediction should be discussed.

C3 Evaluation

This section has also improved considerably and most students have a good understanding of what is expected for each of the criteria. In C2.2 it is not necessary for candidates to justify the controlled variables. It simply is a list of key variables which may be different as the teacher's plan maybe different to their plan.

In C3.4 validity has always been an issue in the past; however centres now have a better understanding of what we expect for this skill area. It is important students critically assess the method they are using.

In C3.5 candidates should either suggest a direction for a hypotheis for another independent variable or give a range over which they would carry out an experiment to investigate another variable.

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