GCE

Rewarding Learning

Chief Examiner's Report

Biology

Summer Series 2018

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.

Contents

GCE BIOLOGY

Chief Examiner's Report

General Comments

This was the second year that AS papers were available for the revised specification. Each of the three papers proved to be an effective discriminator enabling the top candidates to show the extent of their knowledge and understanding, yet allowing weaker candidates to gain credit in many question parts.

Overall, candidate performance was strong across the suite of papers and 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.

Assessment Unit AS 1 Molecules and Cells

There was good differentiation and coverage of the specification with more of the new content from the revised specification included in this year's paper.

It was evident from the majority of candidate responses that students had been well prepared for this paper and that they had completed thorough revision. There was no evidence of students not having adequate time to complete the paper, and they appeared to have clearly understood what was expected in answering each question.

While some questions were challenging, for example Question 3 (c)(i) and (ii), Question 4 (c), Q5 (c) and Question 6 (e), other parts were accessible to all, for example Question 1, Question 3 (b), Question 4 (a), Question 6 (a), (b) and (c) and Section B. It was also pleasing to note that candidates coped well with some of the new content, for example Question 2 and Question 7 (c).

Q1 This was a reasonably straight-forward question covering water potential to start the paper and the majority of candidates correctly completed the calculation. However, a worrying number of candidates failed to complete Part (a)(ii), which required candidates to add an arrow on to the paper, even though this had been in bold on the question paper. It appears that candidates occasionally miss questions like this and they should be reminded to read all the paper carefully and to look for the number of marks awarded rather than an answer line. The rest of this question was well answered.

Q2 This question was based on material that was new to the revised specification and it was pleasing to see how well the students dealt with it. This has obviously been well covered in class with good understanding of the processes involved. Some candidates were slightly confused in the discrimination between a specific type of molecule, i.e. prion, and the larger biological group, i.e. protein, but the majority did achieve at least one mark for this. For Part (c) some candidates lost marks as they failed to compare how viruses and CJD differed; instead they just commented on something viruses had.

Q3 This question on mitosis and the cell cycle started with more familiar material and then progressed into the newer content on cancer treatment. Parts (a) and (b) were both relatively straightforward, although it was noted by examiners that a number of candidates did not attempt Part (a) by placing an X on the diagram; as before, it was assumed that these candidates missed this question on the paper. It was quite often the same candidates that missed both this and Question 1 (a)(ii). In Parts (b)(iii) and

all of (c), lack of detail often prevented candidates from achieving full marks. For example, in Question (c)(ii) although many candidates could confidently state that if the cell went into S phase the damaged DNA would replicate, very few could express that this would mean all future generations would then carry this damage.

Q4 This seven-mark question covered the biological molecules section of the specification. The command terms 'compare and contrast' again appeared to be something that candidates continue to struggle with. Many candidates used bonding as a method of comparison even though the question stated 'apart from bonding'. Very few candidates thought to mention that both consisted of α-glucose and many were too vague in their statement that they were carbohydrate stores rather than energy stores. Part (c) was based on an unfamiliar context but the stimulus material provided should have helped guide candidates to the appropriate response. Many candidates did gain the first mark by assuming the chitin would help protect the crab but only the more able candidates were able to link this to the structure of straight, parallel chains and hydrogen bonds. Again, lack of detail prevented some candidates from gaining full marks.

Q5 This question on leaf structure proved to be an excellent discriminator. Most candidates were able to gain full marks for Part (a)(i). However, Part (ii) proved more challenging. Most could describe the location of the air spaces, but they fared less well when trying to explain why they were there. Part (b) proved challenging for many students with the most common response for Part (i) being stomata rather than guard cell. Part (ii) proved particularly challenging with many candidates referring to water loss through the pore and increasing transpiration. The trend in Part (c) was generally well done but only the very top ability candidates were able to pick out the fact that this trend allowed equal amounts of carbon dioxide into the leaf no matter what the stomatal density was. A worrying number of candidates stated that the stomatal function is to allow light/water to pass into the leaf.

Q6 This question covered the structure of DNA and its replication. Candidates appeared to find Parts (a), (b) and (c)(i) straightforward and these were well answered, although some candidates were unsure of what constituted a nucleotide in Part (a). Part (c)(ii) was generally well answered with most candidates aware that the answer was linked with the order of the bases. Careless language left some candidates not achieving Part (d)(i) and not accessing all marks available for Part (d)(ii). Appropriate detail needed to be included to get full marks; unzipping the strands unqualified was not enough for a mark at AS level – it was important to add that hydrogen bonds are broken. Part (e)(i) was well answered but many were unsure how to express themselves for Part (ii). Vague language which hinted at the answer was often present but was not rewarded as the appropriate level of detail was lacking.

Q7 This question was based on an unfamiliar scenario and required candidates to describe enzyme and inhibitor action and interpret data. Part (a) requiring knowledge of enzyme action was another part in this paper where candidates' inability to provide detail at a level appropriate for AS meant many candidates achieved few marks in a question which should have caused few problems. Many of the answers provided were GCSE standard. However, most candidates answered Part (b) much better and included the correct amount of detail so gaining full marks for their account of enzyme inhibition. Part (c) was from a novel setting and it is pleasing to note that many candidates were able to provide good answers. Part (ii) was more discriminating and it involved candidates using the trends they had identified in Part (i) to suggest how this information in a medical setting could be used. Many candidates understood that troponin remained longer in blood and it was present at a much higher level but often failed to link this with the medical benefits of using troponin in diagnosis.

Q8 (Section B) Many students were able to confidently describe the structure of the cell membrane, although some were lacking in detail (for example, making reference to fluid-mosaic was rarely seen). Candidates also had to link the composition to membrane selectivity and this appeared to be quite challenging, making Part (a) a very discriminating question. More able students could consider movement of polar and non-polar molecules and were able to gain more marks but even they lost marks due to their inability to express and communicate their biological knowledge clearly. Part (b) was answered much better and virtually all candidates were able to achieve at least four out of the six marks available. The most common mark awarded was six marks. Those candidates that did not achieve full marks generally lost them by not considering phagocytosis and pinocytosis at all or confusing them as part of exocytosis rather than endocytosis.

Assessment Unit AS 2 Organisms and Biodiversity

There was a wide range of marks awarded to candidates in this paper. Those obtaining high marks displayed a sound grasp of the subject content and well-developed skills in application. Many candidates lost marks due to their inability to express and communicate their biological knowledge clearly at a level expected at AS. Additionally, there was evidence that some candidates did not read the questions carefully enough resulting in the answers provided not always being in line with the questions as asked or giving a GCSE level answer. Comments on individual questions and their responses appear below.

Q1 This question on terminology was well answered by the majority of candidates. Sucrose is now well known as the transport medium within phloem; many weaker candidates confused myoglobin with haemoglobin and suberin with lignin. Spelling was sometimes an issue in this question; credit was given to those candidates who were unable to spell the words accurately, but who could produce an answer that was broadly phonetically correct and could be recognised out of context. The level of poor spelling may indicate that students rarely write down these words and therefore rely on visual recollection.

Q2 This eight-mark question assessed candidates' knowledge of the structure of blood vessels, tissue fluid and cardiovascular disease. This question proved to be discriminating with many candidates giving GCSE level answers. In Part (a) a disappointingly high number of candidates stated that thick artery walls 'created' the high pressure or described the artery wall as being thick or the lumen as being small as a consequence of the high pressure. When referring to the large lumen, only the more able candidates were able to link this to reduced friction; many gave vague answers such as 'easier for blood to flow' unqualified. A small number of candidates made reference to valves, which was not credited as valves did not appear on the diagram. Part (b)(i) asked candidates to discriminate between atherosclerosis and atheroma and their effects on blood flow. Of the three marks available the last mark on the narrowing of arteries and reducing blood flow was gained by most candidates. Many candidates failed to precisely identify the build-up of fatty substances in the artery wall or under the endothelium. Few candidates were able to describe the extent of the atheroma build-up to get the first mark. Part (b)(ii) tested new content on the specification; consequently, it is pleasing to note that most candidates were able to correctly identify the test, though not so many were able to identify the coronary arteries, giving arteries unqualified. Part (c) was generally well answered by most candidates.

Q3 This ten-mark question on Fick's law and gas exchange resulted in a wide spread of marks across the candidature and proved to be quite discriminating. Part (a) tested candidates' ability in comparing and contrasting gas exchange surfaces. A significant number of candidates gave GCSE level observations and failed to accurately describe the structural adaptations and many only gave a similarity (rather than including a difference). Most candidates did access the similarity mark but struggled with detail on the contrast especially when explaining the plant feature. In Part (b)(i) – completing the graph - only a small number of candidates failed to get both marks. A lack of accuracy with the dip at 18 hours and the levelling off at -100 were the most common errors. Part (b)(ii) required candidates to go beyond GCSE knowledge of gas exchange in plants. Many misinterpreted the fact that a negative intake was in fact the release of carbon dioxide from the plant. A general lack of detail, such as failure to comment on each of the rates of photosynthesis and respiration or failure to describe the level of light restricted many candidates from achieving full marks. Detail of the compensation point was the mark most frequently answered in the appropriate level of detail. Part (iii) proved challenging with very few candidates achieving both marks. The shading of the graph was correctly done by a majority of candidates, but the concept of net gain of glucose appears to be poorly understood.

Q4 This question on Simpson's Index and biodiversity was well answered by most candidates. The calculation of Simpson's Index in Part (a)(i) was well done by the majority of the candidature, though a surprising number lost one mark by incorrectly rounding the figure to one decimal place. Almost all were able to correctly identify the field with the highest biodiversity as the one with the lowest Simpson's Index value. Part (a)(iii) proved more challenging; although many candidates were able to correctly identify the even spread of species in field B, they did struggle to put the idea of a dominant species into words for the second mark. Part (b) highlighted candidates general misunderstanding of the terms validity, reliability and accuracy. Many gave answers concerning reliability or human error unqualified and failed to identify errors in collecting/recording/calculation of the data. It was evident from some of the better answers that practical experience of field work benefited these candidates. Part (c) was very well answered; the majority correctly identifying the adaptation as being morphological and again most identified that it would make them harder to graze.

Q5 This eight-mark question on the heart and the circulatory system proved challenging in parts to candidates and again produced a wide range of marks. The parts labelled A and B on the diagram showing a TS view of the heart were well identified by the majority of candidates, although a minority incorrectly answered vessels rather than valves. Part (a)(ii) was well answered, with the majority of candidates accessing both marks, although a minority did fail to mention both valves in their answer and so lost one mark. Part (b) was less well done by many candidates as they started their answers describing atrial systole and left little time or space for the description of ventricular systole as required by the question. Description of the cardiac cycle is not novel, so it was surprising how few candidates accurately described the opening of the semi-lunar valves or that the ventricles contract from the bottom of the heart up. Part (c) was commonly answered by vague references to less blood around the body, with only a small minority of candidates describing the reduction in stroke volume or that oxygen needed to be delivered to cells/muscles or the brain.

Q6 This question covered global warming and classification and was well answered by the majority of candidates. Part (a) tested candidates' ability to draw conclusions from data provided. Some candidates lost out on the first (supporting evidence) mark; although they recognised the high levels of carbon dioxide in industrialised countries they often failed to compare this to the non-industrialised countries. The

second mark in Part (a) was accessible to the majority of candidates. In Part (b)(i), many candidates achieved all three marks, although a number lost marks by having mammalia in place of animalia or through mixing up the genus and species name. In Part (b)(ii), spelling was often an issue with eukaryota/eukaryote, but again phonetic spelling was allowed as in question one. Part (b)(iii) was well answered; perhaps surprisingly, many answered it referring to comparative DNA analysis rather than the more traditional breeding definition to produce fertile offspring. Part (c) was an unusual context but well answered by many with some excellent suggestions on the impact of a new species into an area.

Q7 This eleven-mark question on transport in plants was generally well answered although again provided a good spread of marks. In Part (a)(i) the trend was often poorly described as just increasing, when increasing steadily was required for the mark. The other two (explanatory) marks needed both the parts of the leaf involved (spongy mesophyll and stomata) and the processes (evaporation and diffusion). In Part (a)(ii), many candidates failed to recognise the link to the very regular rate of transpiration and instead referred to no anomalous results or it being a straight line, which was not enough to get the mark. Part (b) was well answered with a majority of candidates drawing the line in the correct place, with only a small number adding the line above the one already present. In Part (b)(ii) it was good to see many candidates recognising the idea of less kinetic energy at the lower temperature and so accessing the first mark, although many referred to less water loss instead of slower water loss. Part (c) was very well answered by most candidates; in Part (i) the two marks were often awarded, with many descriptions of tension accepted and lignin almost always referred to by candidates. In Part (ii) many candidates recognised the spiral shape of the young xylem; while most also linked this to the ability to stretch and elongate, a small number mixed up the spiral with pitted xylem and referred to lateral movement of water.

Q8 (Section B) This question assessed candidates' knowledge and understanding of the negative impacts of agricultural practices on biodiversity and required them to name two initiatives put in place to increase biodiversity. This essay required the description of a wide range of agricultural practices to receive full marks. Some practices such as monoculture, hedgerow damage/removal, artificial fertiliser and pesticides were well described. When describing the loss of nutrients in soil due to monoculture many candidates missed the idea that it was due to the same crop being grown year after year. It was good to see many candidates including the importance of wildlife corridors and predator strips in their answers. Few candidates accessed the marks on poor biological control or the effect of increased stocking rates. There is still some evidence of candidates incorrectly linking slurry to eutrophication, and some who link reducing levels of oxygen to plant death rather than a rapid and substantial increase in bacteria numbers. A significant number of candidates did get both available marks for the effect of drainage schemes on wetland habitats. In the naming of initiatives that have been introduced to conserve habitats and promote biodiversity, many candidates lost marks through not describing the initiatives fully, for example answering DAERA rather than DAERA agri-environmental schemes. A significant number of candidates used up time and space on this section describing the various schemes rather than just stating the name of the scheme as asked. In general, if candidates were well prepared for this essay they were rewarded with high marks, although less well-prepared candidates were still able to access some of the more straightforward marks.

Assessment Unit AS 31 Practical Skills

This was the second year in which a written examination was used to assess AS practical skills in the revised specification. As in 2017, the examination succeeded in providing meaningful differentiation across the candidature in the assessment of practical skills.

As with the 2017 paper, this fifty-mark paper covered many of the practical activities identified as being part of the AS course. There was a range of question types including outlining 'recipe' practical methods, drawing a block diagram, interpreting photographs and interpreting data.

Q1 This was a relatively straightforward five-mark question covering chromatography. Most candidates obtained four or five marks. Part (b)(ii) proved the most differentiating with a significant minority of candidates making errors in the calculation of Rf. Common errors included measuring from the base of the chromatogram rather than the origin, measuring to the top of the chromatogram rather than the solvent front and measuring to the bottom of the spot rather than the leading edge or centre.

Q2 Interpreting and describing plant distribution in woodland and grassland was tested in this question. Many candidates found it demanding and very few scored full marks in this four-mark question. Part (a) required candidates to describe the distribution of lesser celandine along a transect that ran from the centre of a small woodland out of the wood and into grassland. This was often poorly done with many candidates failing to link plant distribution to habitat; candidates frequently linked plant distribution to distance along the line transect rather than the type of habitat, i.e. woodland or grassland, at any particular point. This was disappointing as the question clearly stated 'with reference to habitat.' Part (b) was often well done with many candidates appreciating that the peak in lesser celandine distribution at the wood edge was due to increasing light intensity and reduced competition from grassland plants.

Q3 Identifying tissues in a photomicrograph and calculating magnification were tested in this six-mark question. In Part (a), many candidates incorrectly answered lumen as the tissue in the centre of the photograph of the artery. Blood was the correct answer and more careful reading of the question by many candidates would have enabled them to achieve this mark. Most candidates could provide evidence that indicated that the photograph was a section through an artery rather than a vein (Part (b)) and could calculate the magnification in Part (c).

Q4 Question four tested candidates' understanding of how to use colorimeters, their ability to draw tables and analyse and explain the results from an investigation into the effect of temperature on membrane permeability. Part (a)(i) required candidates to identify how the colorimeter could be calibrated to 100% transmission and this was well done. Part (ii) proved more demanding with only a minority of candidates accurately describing why filters are used in colorimeter investigations. Only the candidates more secure in their knowledge answered that filters provide maximum or greater range of results in the investigation – many candidates failed to gain credit by answering that filters increased transmission, gave better results or provided a range of values. Most candidates achieved all three marks for completing the table accurately in Part (iii). Part (iv) – explaining the results of the investigation – proved more demanding. Most candidates could appreciate that with increasing temperature the membrane becomes more damaged but fewer could explain that this resulted in more pigment (betalain) entering the water at higher temperatures (and leading to lower values for % transmission). Part (b) proved very discriminating. The question did nor specify whether the beetroot was kept in the same water bath (with the temperature of the water bath being incrementally increased) or whether the same beetroot was immersed into different boiling tubes in a series of water

baths of increasing temperature. Either way, candidates were expected to deduce that damage to beetroot membranes would be progressive over time and greater (compared to Part (iv)), due to the longer time in water at higher and damaging temperatures. A minority of candidates could answer that consequently the % transmission would be less (at higher temperature) due to this accumulated damage. Many candidates assumed that transmission would be lower at higher temperatures as all the beetroot pigment would have already escaped at lower temperatures – these candidates obviously assumed that the beetroot was transferred to new boiling tubes in the different water baths each time.

Q5 In this question candidates had to draw a block diagram of a section through the ileum from a photograph. This was usually very well done with many candidates obtaining all five marks available. Where marks were lost, this was often for inaccurate labelling or failing to draw all the layers required in the question.

Q6 Candidates had to describe how to carry out an investigation in order to measure the average water potential of cells in potato tissue using the weighing method. As with the 2017 paper, candidates did well in this type of 'recipe' method question. Most candidates showed good understanding of procedures involved but lack of detail in describing the graph involved cost a significant number of candidates a mark. It was important that candidates made clear that the percentage change in mass was on the y-axis with solute potential/concentration of immersing solution on the x-axis. Drawing a graph of percentage change against concentration of sucrose was credited but not drawing a graph of concentration of sucrose against percentage change of mass.

Q7 The effect of immobilisation on enzymes was the context of this ten-mark question. Parts (a) and (b) proved to be two of the most discriminating question parts on the paper. In Part (a), a majority of candidates could deduce that the amount of lactose remaining decreased each time the milk was poured through the barrel of the syringe and that this was due to the lactase breaking down the lactose. However, many fewer candidates were able to add that the rate of breakdown decreased progressively as each time the milk was passed through the syringe there were fewer lactose substrate molecules remaining. In Part (b) candidates were asked to explain the difference between the first set of results (Graph 1) and the results when the milk was passed through the syringe with smaller beads (Graph 2). The more able candidates were able to explain that the rate of breakdown was faster in Graph 2 each time due to the smaller beads having a greater surface area and therefore more enzymes being in contact with the lactose leading to more collisions between substrate and enzyme or more ES complexes being formed. In Part (b) a significant minority of candidates produced answers lacking in clarity in the sense that it was unclear whether they were referring to the difference between Graph 2 and Graph 1 or were referring to number of times through the syringe in Graph 2. Only a minority of candidates were able to identify two appropriate variables that should have been controlled in the investigation (Part (c)). A disappointing number of candidates answered pH and/or number of beads, neither of which were credited. In Part (d) most candidates could describe a method to identify if the milk at the end of the investigation contained glucose.

Q8 Part (a) of the final question on the paper tested candidates' ability in calibrating an eyepiece graticule. Most candidates appreciated that the left edges of the eyepiece and stage micrometer scales should be lined up (typically by superimposing the two 0 grid lines). However, many candidates failed to obtain the second marking point by stating that the value on the stage micrometer corresponding to the end (the 100 line) of the eyepiece graticule should be recorded (even though two grid lines on the scales may not line up at this point). The more able candidates were able

to state that each small division on the stage micrometer was 10µm and that the length of each eyepiece unit could be calculated by dividing the distance on the stage micrometer in micrometres by the number of eyepiece units used in the calibration. Part (b) proved to be equally demanding with only a small minority of candidates obtaining both available marks. Many candidates could appreciate that the reduction of mean cell length was due to water loss, but many fewer went on to make reference to the cells losing turgor as a consequence of this water loss – it is the loss of turgor that results in the smaller length.

Principal Moderator's Report

Assessment Unit AS 32 Practical Skills in AS Biology

The standard of the practical skills assessed at AS level has improved from last year and the quality of the evidence submitted reflected this. Many of the recommendations from last year's agreement trials and TAC6 comments were taken onboard by the majority of centres. Again any issues were from centres which had not attended agreement trials. Teacher assessment agreed closely with CCEA expectations and correct administrative procedures were followed.

There is a still a concern in some centres regarding the quality of table construction and graphical presentation. It is important that candidates are shown the importance of recording and displaying data correctly consistently which will help in their examinations. Also where required identification and brief explanations of trends should be given. In a few cases this was absent or did not explain the outcome.

Presentation of evidence in general is excellent with candidates and teachers making good use of photographic evidence. It is important that the work submitted clearly indicates that the candidates have done the practical task even if the outcomes in terms of result may not always be as expected.

Biological Molecules

Most centres have embraced the idea of analysing food samples or unknown solutions with the biochemical tests in order to establish the presence or absence of biological molecules. A table of these results including identification of the molecules is what is expected in terms of evidence.

Chromatography

An issue for many centres was the lack of separation obtained from their chromatograms. If this occurs then a copy or photograph of the chromatogram should be recorded and then the pupils could use another chromatogram to measure and calculate RF values. (It is useful to retain copies of chromatograms with good separation!). Evidence should include recorded measurements, calculations of RF values and where used identification of amino acids from unknowns or with comparison with published values.

Enzyme Investigations

There was little variation in the nature of the investigations amongst the centres, but the quality of recording and graphical presentation was inconsistent. However the explanations given for the results are improving in standard. It is important an independent variable is investigated except when using an immobilised enzyme. Two investigations can be submitted as part of the required seven practicals.

Using a Colorimeter

A colorimeter can be used in the construction of a starch calibration curve. The recording of these results and their plotting on a graph along with a brief explanation of the technique/ outcome of the results. Also, the colorimeter can be used to investigate the factors which affect the permeability of beetroot membranes. Evidence is again a table and graphic results and a conclusion describing and explaining the results. It is important candidates explain why the independent factor they are investigating affects the permeability of the membrane. The quality of caption for the tables and graphs was poor in this investigation.

Using a Graticule

There were more centres using this piece of apparatus and some excellent photographs and calculations were submitted for assessment. It was good to see a variety of different cell types being measured which was obvious by the different calculations which were given. If it is not possible to submit photographs of the cells then a good description of the type of cell and the measurements taken should be given.

Osmosis Investigations

These were the most popular investigations with both determination of water potential and solute potential being completed by the majority of centres. The evidence was well presented indicating a good understanding of both practicals. Some centres still compare carrot and potato water potentials which is welcomed as it is enables the pupils to understand the principles of the investigation and links it to other areas of the specification.

A red onion is a useful tissue to use to find the solute potential as it is much easier to see if plasmolysis has occurred.

Root Tip Squash

It is good to see many centres attempt this practical. It is difficult to obtain clear examples of cells undergoing mitotic division and a helpful tip is that some species of plant undergo mitotic division in the early morning and go into interphase in the afternoon.

Pupils should draw some of the cells in their squash or photograph it and identify any obvious stages. If there are not clear examples of division then a prepared slide could also be given to help them identify some stages.

It is important that pupils look at the cells through a microscope rather than a prepared photograph.

Block Diagrams

There were many examples of these submitted by centres and they were generally of a high standard. It is important to remember that it is only the layers that are required and not individual cells. When marking these the guidelines to be used would be the same as would be required in an exam. Lines should be solid and not sketchy, layers should be proportional and represent the slide or photograph being used and obvious layers should be drawn and labelled. A photograph or copy of what is being used for the drawing should be included to help moderation.

Dissection of a Heart

The quality of the heart dissections and photographs submitted for evidence was of a very high quality and greatly improved from the previous year. There was a mixture of drawings and photographs for the internal features with obvious features being labelled, some with little flags made from cocktail sticks! However, it is important that the external structure is drawn rather than a photograph.

Sampling Techniques

This area was probably the least undertaken by the centres, however the advice given last year has been heeded by teachers. When these practicals were carried out they were well set out investigations with an obvious independent variable being investigated. The presentation of the data as evidence was appropriate to the investigation and conclusions attempted to explain the outcomes.

It is always good to see ecological investigations.

Overall there has been an improvement in the quality of the evidence which has been submitted for moderation.

Chief Examiner's Report

General Comments

This was the first year that A2 papers were available for the revised specification. There are a number of significant differences (in addition to a change in some content) between the revised A2 papers and the legacy papers they replaced.

These differences include:

- the introduction of a new 60-mark written paper (ABY31) to help assess practical skills
- the main 'theory' papers (ABY11 and ABY21) now have 100 marks (rather than 90) and these papers no longer directly assess practical activities identified in the specification.

Each of the three papers in 2018 contained a variety of questions assessing the different skills which are developed when studying biology at this level. Each paper was successful in discriminating between those candidates who were well prepared for their examinations and those whose knowledge and understanding was less secure, and/or were less skilful in analysing data or answering questions involving unfamiliar scenarios.

It is encouraging to note that many A2 candidates proved their ability to write excellent answers to the more challenging questions, including those which contained novel content. Analysis of candidate performance clearly shows that while a majority of candidates performed well in those questions testing recall and understanding, only the more able candidates performed well in those questions testing analytical and evaluative skills, particularly if the questions were set in an unfamiliar context.

Assessment Unit A2 1 Physiology, Co-ordination and Control, and Ecosystems

Candidates taking this unit obtained a range of marks and the increase in the number of marks available to 100 increased the spectrum of specification topics examined. Some obtained high marks displaying a sound grasp of the subject content and well-developed skills in application. Many question parts provided an opportunity for less able candidates to exhibit the extent of their knowledge and although some questions proved to be challenging, none were beyond the ability of the candidature. Overall, there were very few scripts with a significant number of blank spaces and in most questions, candidates attempted a response. Most centres had clearly prepared their candidates to a good standard and there was evidence that the content of the specification had been well taught in general. Another issue involved the candidates' mathematical skills, whilst able to calculate part of the answer many candidates then lost marks in unit change or consequential processing of relatively straightforward terms. Moreover, many candidates lost marks due to their inability to express and communicate their biological knowledge

clearly and unambiguously and there was evidence that some candidates did not read the questions carefully enough. Candidates either failed to address the question entirely or only gave partial answers thereby preventing them from accessing all the available marks. In a significant proportion of the candidature responses were little more than GCSE standard and it should be reinforced that language and terminology commensurate with the level must be used. This was exemplified when candidates had been asked to recall a definition.

Q1 This question was relatively straightforward, requiring recall of key concepts in photoperiodism. Many candidates achieved full marks in this question, but a significant proportion did not. Some candidates were not able to identify the pigment, whilst other seemed unclear regarding its location. In Part (c) a minority of candidates lost marks due to 'dark' light resulting in a phytochrome alteration. Candidates should be reminded to read the entire question carefully.

Q2 Part (a) of this question was synoptic to AS1 and it was surprising that a significant number of candidates gave the responses in reverse order. Part (b) was somewhat more applied to the structure of the cone but again tested several of the elements candidates would have been familiar with from AS1 and 2, for instance the stacks of membrane providing increased surface area etc. Candidates generally scored well here. It was pleasing to note mitochondria associated with ATP (not energy) production.

Q3 The context of this question, related to population, is familiar to candidates and the question provided a range of marks. In Part (a) a significant number of candidates failed to pick up the mark due to inability to state the precise definition of a population. This indicates a general lack of learning on the part of the candidates and they should be reminded of the importance of the specification when giving definitions. In Part (b) some candidates lost the mark by not making the link from the stem that an r-selected species will show a typical 'J'-shaped growth curve often showing a wide plateau at the peak. Part (c) was generally well answered with candidates achieving higher marks. Generally, language and terminology represented the main barrier to achieving full marks. A minority of candidates stated the features of K-selected species.

Q4 This question relating to the kidney had some straightforward sections and other more novel sections. In Part (a) a minority of candidates failed to achieve the full mark due to not identifying the parts of the urinary system correctly. Part (b) was more novel and in Section (i) candidates generally identified the trend and explained it. It was pleasing to note that a significant number of candidates explained the selective reabsorption of glucose both by facilitated diffusion and active transport. Section (ii) proved more challenging to candidates as they had to link the trend to what happens along the length of the loop of Henlé. Candidates need to be clear in their explanation of the cause and consequence of features of the activity. The different permeability of the descending and ascending limbs to water, the transport of ions from the ascending limb to the interstitial fluid and the consequence of this on its solute/water potential and this as a driving force for osmotic extraction from the descending limb must be clear to candidates. Part (c) was generally well answered. Part (d) however, posed some problems to candidates. In Section (i) a significant number of candidates trotted out a control variable without considering how entirely appropriate it was in context. Candidates should be encouraged to give suitably contextual responses to questions of this type. In Section (ii) it was clear that candidates understood the role of ADH but again had difficulty applying this knowledge to a more contextual framework. Candidates should be encouraged to remember the use of important terms (for example more, greater) that allow statements to achieve relative status. Few candidates achieved full marks here.

Q5 In Part (a) most candidates successfully obtained at least two of the four marks. In Part (a)(i) and (ii) many candidates successfully constructed a suitable expression for productivity and used it to calculate an answer for production. Some candidates lost marks here for expressing the answer on scientific notation although the x106 was given on the answer line. Section (iii) of this question was well done by candidates. However, some candidates still have difficulty in calculating percentages. In Part (b) (i) a significant number of candidates lost at least one mark (if not both), describing and not explaining the trend shown in the table. Candidates were somewhat unclear about the importance of nitrate and the consequential use of the ion in the production of plant protein. Answers to this question highlighted poor expression by many candidates and often answers little above that expected at GCSE standard. In Section (ii) candidates did not provide detail as to why nutrients were depleted or recovered by the fields appropriately. Section (iii) was generally well answered. Eutrophication, a consequent effect of the disadvantage of using inorganic fertiliser (high solubility/leaching) was often described incorrectly.

Q6 In Part (a)(i) a surprisingly large number of candidates did not identify the kingdom correctly as Prokaryotic and instead answered bacteria or indeed the wrong kingdom Protoctista. T his was surprising since the question was directly repeated due to this pattern of answer from the 2017 series. Although incorrect responses were fewer in number, it suggests poor preparation on the candidates' behalf. Section (ii) stretched candidates slightly but preparation for ABY21 would have served them here. In Part (b) candidates often picked up the trend description but several included the full time period and not that instructed in the stem. They were not penalised for this. Most candidates went on to get a second mark based of better hospital regimes of hygiene or treatment. However, fewer candidates achieved the third mark which needed the implication of new strains of MRSA arising/resistant to new antibiotics and not just the bacteria becoming resistant to antibiotics (as they already are). Part (c) was well answered in general, suggesting good preparation for a new topic on the specification. Part (d)(i) again presented issues with candidates not having learned a definition for the term pandemic. Section (ii) provided candidates with a familiar platform regarding the nature of RNA and reverse transcriptase. Candidates did have difficulty with the consequential significance of reverse transcriptase in that few were able to get the importance of allowing integration of viral genetic material into the host genome. Section (iii) suffered from poor terminology.

Q7 The concept of excitatory and inhibitory neurones has become more commonly examined recently and the standard of candidate response reflects this. This question did however, require candidates to link statements to gain marks. Part (a)(i) required candidates to separate the ideas of receptor binding increasing membrane permeability and the influx of positive ions to achieve both marks. Section (ii) was answered effectively with many using hyperpolarisation in the correct context. In Section (iii) the first mark needed the idea of hydrolysing the neural transmitter and its concomitant release from the receptor and the second mark was for the consequence of this. In Part (b)(i) candidates missed marks when not making appropriate links between the blocking of the active site and the E-S complex not forming and further the transmitter remaining bound and the innervation of the neurone. Most candidates in Section (ii) were able to suggest the idea that some organisms were resistant and their reproduction could give rise to a resistant population. Again, level of expression caused problems here and resulted in mark loss.

Q8 A disappointingly large number of candidates were not able to obtain the first mark in Part (a)(i) since they referred simply to breastmilk and did not state colostrum or placental transfer. This had been insisted upon in many previous mark schemes. About 50% of candidates were able to obtain the mark in Section (ii) with ethical concerns being a common misconception here. Part (b) of the question contained some synoptic elements which proved challenging to many. Poor use of terminology and relatively inaccurate language prevented many candidates from obtaining marks. Sections (i) and (ii) showed a range of marks and proved discriminating. Part (c)(i) again posed problems for the candidature and when asked for the definition of an antigen poor expression and a relative unsureness was obvious. Section (ii) was well answered by most candidates and this was pleasing given the status of ELISA as a new topic. The question was relatively straightforward reflecting its first appearance. The calculation involved in Section (iii) reflected the concept of dilution as required by the specification and provided a range of marks. Candidates are getting better at unit conversion. Section (iv) provided a broad platform in a context that candidates are very familiar with now regarding immune response. The mark scheme credited a range of responses and many candidates scored well. The question did discriminate since some of the marking points required a broader discussion to achieve the mark. Part (d) was relatively novel but candidates dealt with it well and gave good responses, the most common of which was the second mark point regarding vaccination and active response. Pleasingly, some candidates recognised that over-crowding could contribute to disease spread.

Q9 This question provided a good platform for candidates to discuss their understanding of population interactions. The inclusion of graphs as stimulus was more novel. Candidates dealt well with this question and were able to describe the interactions effectively and furthermore could discuss the significance of the interactions. However, a proportion of candidates did confuse the interactions and the consequences of them on the populations involved. In Part (a) of the question candidates successfully discussed the idea of competition but did not tend to identify that it was interspecific, so again the importance of examining stimulus material in detail should be reinforced. Candidates appeared comfortable with their discussion of mutualism but did not give an appropriate example. Part (b) provided a less usual predator prey relationship to analyse but candidates generally dealt well with it and furthermore suitably compared and contrasted the relationship with grazing and parasitism. Candidates have successfully migrated to the banded mark scheme model and candidates generally scored a good range of marks in this question.

Assessment Unit A2 2 Biochemistry, Genetics and Evolutionary Trends

This paper proved to be the most challenging within the 2018 A2 suite of papers. Relatively few candidates scored in excess of eighty marks. Most candidates made an attempt to answer all the questions and question parts and there was very little evidence of candidates finding completion of the paper tight for time.

Q1 Overall candidates did surprisingly poorly in this six-mark question on insects and arthropods. In Part (a) candidates had to identify two characteristic arthropod features from the photograph. Many candidates were credited for answering jointed limbs, but most candidates struggled to get the second mark. Fixed number of (metameric) segments was rarely given but many answered the more vague 'metameric segmentation present' which was not credited. In Part (b)(i), only a minority of candidates could define bilateral symmetry accurately; this question part proved more difficult than expected. Similarly, two marks were seldom awarded

for Part (b)(ii). Many candidates picked up a mark for stating that in organisms with bilateral symmetry, the 'head' or front of the body could be used to test the environment or that sensory receptors could be grouped here. However, relatively few answered that bilateral symmetry allowed movement to be more streamlined. Part (c) required candidates to state why insects are the most successful animal group in terms of number of species. This was very poorly answered even though one of the allowable answers 'the basic body plan has facilitated rapid evolutionary development in many directions' was straight from the specification.

Q2 This eleven-mark question on anaerobic respiration was well done by a majority of candidates, yet it provided good differentiation across the candidature. Part (a)(i), the location of anaerobic respiration in the cell was invariably well done enabling the vast majority of candidates to make a successful start to the question. Part (a)(ii), required candidates to use the information provided to state why anaerobic respiration was a very rapid process (compared to aerobic respiration). This was usually well done; most candidates were able to explain that anaerobic respiration involved only a short part of the aerobic pathway or that fewer stages or steps were required. A minority of candidates lost the mark through using inaccurate statements such as 'only one reaction is involved'. Part (iii) proved more demanding. Candidates had to describe the importance of the oxidation of reduced NAD in the pyruvate → lactate stage. While most candidates had a general idea of the significance of this, only those candidates who wrote full answers describing the subsequent role of the reconverted NAD in glycolysis were awarded. Part (b)(i) required candidates to suggest why many organisms favour aerobic respiration over anaerobic respiration. This was generally well answered with many candidates obtaining the two marks available by stating that aerobic respiration produces more ATP, i.e. 38 compared to 2, than anaerobic respiration. Many candidates obtained one of the marks by stating that anaerobic respiration produces toxic waste substances. Part (b)(ii) was less well answered with only a minority of candidates making it clear that anaerobic respiration in mammals provides additional ATP, above and beyond that produced in aerobic – it is not that anaerobic respiration replaces aerobic respiration in mammals when oxygen levels are low. A greater number of candidates could obtain the second mark by providing a situation in which the 'extra' energy could be beneficial, for example in helping a prey animal escape from a predator. In Part (c)(i) most candidates were able to shade the part of the graph that refers to the oxygen debt; a minority lost the mark by shading down to the x-axis. In Part (ii), a majority of candidates could state the function of the oxygen debt. Part (d), the final section of the question, was often well done. A majority of the candidature could describe two differences between anaerobic respiration in plants and animals. Many candidates could differentiate between the end products (lactate and ethanol) produced and a significant number could answer that carbon dioxide is only produced in plants. A smaller number of candidates answered that the final product (lactate) is converted back to pyruvate in animals but the ethanol is released into the substrate without reconversion in plants.

Q3 Question three was a twelve-mark question testing the analysis of data involving new specification content (the metabolism of codeine). Part (a) was usually well done with a large majority of candidates obtaining at least three of the four marks available. Part (b)(i) required candidates to analyse data involving the different types of codeine metabolisers across three ethnic groups. Those candidates who could take an overview and summarise the information provided scored well whereas those who simply listed data provided from the table scored less well. Part (b)(ii) differentiated well between candidates and relatively few could identify two variables that would have been controlled in the investigation. The most common correct answers included dosage of codeine, the time between administration of codeine and testing and the mass/weight of individuals involved. A surprising number of

candidates answered temperature which of course was not awarded. Part (c) was the least well done question part. Candidates had to use information provided to suggest a genetic basis for ultra-rapid metabolism. Many could suggest that individuals with ultra-rapid metabolism were homozygous, but fewer went on to state that they were homozygous for a functional enzyme. The second mark proved to be more demanding with only a minority of candidates describing that this would result in a high level of (functional) enzyme being present.

Q4 Photosynthesis was the topic in this thirteen-mark question that allowed virtually all candidates to achieve some marks, yet proving discriminating in a number of question parts. Part (a) was well answered by the majority of candidates. In Part (i) most candidates could state that leaves are normally green as they absorb light from the red and blue parts of the visible spectrum (they do not absorb green light) and that the green wavelengths are reflected. Similarly, in Part (a)(ii), a majority of candidates could describe what is meant by the term action spectrum. Part (b) required candidates to analyse a graph showing how the environmental factors of light, carbon dioxide and temperature affected the rates of photosynthesis. This proved to be more demanding with only a very small minority of the candidature obtaining all the marks available for Part (b). In Part (b)(i), very few candidates were able to suggest how the rate of photosynthesis could be measured in different environmental conditions. Only a small percentage of candidates suggested that the most straightforward way of doing this was to use a water plant and measure the amount of oxygen given off over time; a surprising outcome, considering that this is no more than GCSE knowledge. Part (ii) also proved to be discriminatory; while a significant number of candidates could state that at higher light intensities there would be more photoactivation and therefore more electrons emitted or more electrons entering the carrier systems, only a small number went on to state that this resulted in more ATP and NADPH being produced. Part (iii) asked candidates to explain why there was more photosynthesis when there was both more carbon dioxide available and higher temperatures. Only a very small minority of candidates obtained all four marks available. While many candidates could explain that with more carbon dioxide there would be more carbon fixation and that more glycerate phosphate would be produced, few went on to explain the effect of the higher temperatures as well, thereby denying themselves access to all the available marks. In Part (c), many candidates were able to answer that a plant response to high transpiration rates in higher temperatures is the closing of stomata with the subsequent effect of this on intake of carbon dioxide. However, fewer went on to answer that this resulted in less glucose/starch/other organic products being formed and therefore less growth.

Q5 This eight-mark question involved a comprehension-type question comparing some of the differences between prokaryotes and eukaryotes. As with question four, most candidates could pick up some of the earlier marks, yet only the most able could score highly throughout. In Part (a), most candidates could state one difference between prokaryotic and eukaryotic cells. However, this mark was not universally obtained with a small number of candidates mixing the two terms up. Part (b)(i) was also generally well done; most candidates could use the information provided in the passage at the start of the question to give one feature which increases genetic variation and one which decreased it. Part (b)(ii) was a four-mark question which proved more demanding. Although essentially a comprehension question in nature, many candidates failed to appreciate this, and also failed to understand that the question was about bacterial populations, rather than changes within a single population. Candidates who incorrectly assumed that the question required just an account of directional selection in an antibiotic-resistant context were normally able to score two of the four marks available. Part (b)(iii) proved demanding, with only a small minority of candidates obtaining both available marks for suggesting why it can

be difficult to classify many types of bacteria. While many candidates could answer that many bacterial species are morphologically similar or are very small to study or that their genomes are very variable, few could put two of these reasons together.

Q6 The structure and distribution of mosses were covered in this question which also tested the ability of candidates to calculate and add 95% confidence limits. In the main, candidates did very well with a majority scoring most of the eleven marks available. Part (a) was well answered with a majority of candidates being able to identify rhizoids from the diagram (Part (i)) and being able to state two ways in which the leaf-like structures in mosses are different from true leaves (Part (ii)). Part (b) (i) required candidates to calculate 95% confidence limits and in the main this was well done with a majority of candidates obtaining all three marks. Similarly, most could then plot the final bar and associated 95% limits on the bar chart (Part (ii)). Part (iii) asked candidates to describe *Sphagnum* distribution using the information provided and then suggest reasons for this distribution. This proved to be more problematic for many candidates. Many candidates lost a mark by describing the moss distribution in terms of sample site numbers rather than height or slope (on the mountain). A greater number of candidates were able to pick up the second mark by suggesting that the *Sphagnum* distribution was linked to drainage in that there was more moss where it was flatter (i.e. at the base and top of the mountain) where drainage would be poor and conversely less where drainage would be good (i.e. on the steeper slope of the mountainside). Many candidates could obtain at least one of the two marks available for Part (c) by explaining an advantage of ferns reaching heights of one metre or more. Candidates were credited for stating that in doing this there would be less competition for light therefore the ferns could photosynthesise more or that this would facilitate spore dispersal thus reducing competition among offspring or increasing the possibility of colonising new areas. However, only a minority of candidates produced sufficiently detailed answers to obtain both available marks.

Q7 This twelve-mark question tested candidates' ability in genetics. Most candidates did well overall in this question but very few obtained full marks. In particular, candidates struggled with Part (a). Only a very small number of candidates could describe Mendel's second law of inheritance in terms of the independent assortment of alleles. Most candidates did well in Part (b). In Part (b)(i), a majority of candidates could identify the genotypes that produced dark red and blue coat colours in Doberman dogs. Similarly, in Part (ii), a majority could complete the genetic cross from the parental genotypes provided. Where marks were lost it was usually due to candidates failing to clearly link offspring phenotypes to genotypes. This was disappointing as only by doing this could candidates clearly show the ratio of genotypes produced in offspring. A surprising number of candidates duplicated their work by completing a sixteen cell Punnett square with two identical Bd and two identical bd lines. Part (c) required candidates to identify the lethal genotype produced as a consequence of a straightforward monohybrid cross and this was usually well done. In Part (d), most candidates could state that it would not be appropriate to apply the Hardy-Weinberg equation to dog populations in general due to the selective nature of much dog breeding.

Q8 The penultimate question on the paper tested gene technology and, in particular, gene therapy. Part (a)(i) required candidates to name the group of organisms used in producing insulin by genetic engineering. This was well done by many candidates although a significant minority lost the mark by just stating GMOs or GEMs (rather than bacteria or prokaryotes). In Part (a)(ii) candidates had to suggest a medical advantage in producing insulin by genetic engineering rather than by the older method of obtaining insulin from dead livestock. Across the candidature there was a

wide range of acceptable answers provided, for example the genetically engineered version could be more easily produced in the high volumes required (due to the rapidly increasing numbers of people with diabetes) or that as the genetically engineered insulin was 'human' it was less likely to produce allergies. Part (b) asked candidates to suggest a reason why only a small proportion of lung cells gain the functional gene in traditional gene therapy (as for cystic fibrosis). This was also well done with the most common answers being the difficulty in the functional gene reaching all parts of the lung system and the likelihood of vectors being destroyed by the body's immune system. The synoptic question Part (c)(i) proved more discriminating and was only successfully answered by a minority of candidates. Candidates had to appreciate that bone marrow transplants would initiate cell-mediated or T-cell responses (rather than just a B-cell response) and that this was initiated by the presence of non-self cells or antigens. Part (c)(ii) asked candidates to explain the benefits of editing genes in stem cells compared to traditional gene therapy in the treatment of sickle cell anaemia. This four-mark question part as expected proved to be very discriminating with only a very small minority of candidates obtaining more than two marks. Many candidates could answer that the gene editing would be long term or permanent and that there would be no need for reapplication (as with traditional gene therapy). A smaller number could answer that there would no need for vectors (therefore avoiding issues caused by these) and/or that tissue rejection was less likely. Other allowable answers such as allergic responses are less likely, all the new haemoglobin produced will be normal, or that there would be fewer issues over gene expression (as the edited DNA would be incorporated fully) were much less frequent. A surprising number of candidates stated inaccurately that the functional genes could be passed on to offspring. Furthermore, a disappointing number of candidates described the disadvantages of traditional gene therapy rather than answering the question as asked. Many candidates could pick up the mark for Part (c)(iii) by suggesting that the editing technique could affect the genome in unexpected or unpredictable ways or that the harmful mutation would still be passed on to the offspring.

Q9 (Section B) The essay section on this paper included a straightforward twelve-mark question on protein synthesis and a six-mark question on epigenetics. Both sections were usually well answered and the nature of the question allowed those candidates who were secure in their knowledge to score well. A majority of candidates were able to write well balanced accounts in Part (a) - describing and explaining the roles of DNA, RNA and ribosomes in protein synthesis – giving many or most of the marking points on the mark scheme. Those candidates who scored less well often lacked a clear understanding of either transcription or translation; in addition, a number of candidates mixed up transcription with DNA replication. A minority of candidates extended their answers beyond that required to describe the role of the Golgi apparatus in protein modification and even the roles of protein within the cell. In Part (b), those candidates who clearly understood the topic of epigenetics scored well, often achieving five or six of the six marks available. A minority of candidates dropped marks when explaining why enzymes associated with liver function are only produced in liver cells, referring to the enzymes being switched off in other non-liver cells, rather than the genes producing the enzymes being switched off. Nonetheless, it was pleasing to see how epigenetics, content new to the specification, was well understood by the majority of candidates.

Assessment Unit A2 31 Practical Skills

This sixty-mark paper covered a majority of the practical activities identified as being part of the A2 course. There were a range of question types including describing 'recipe' practical activities, identifying structures in electron micrographs, calculations, describing how to carry out a dissection of a named organism, identifying controlled variables and possible errors in investigations as well as data analysis and statistics. Overall, most question parts were accessible to the vast majority of the candidature yet were successful in differentiating among candidates.

Q1 This three-mark question covered electrophoresis and it proved to be surprisingly discriminatory, with only a small minority of candidates obtaining full marks. Most candidates answered Part (a) correctly, being aware that the buffer allows the current to flow thereby allowing the DNA to move across the gel. Most candidates found Part (b) more difficult and the majority failed to state that the DNA from each well would appear as fragments or bands at different positions along the length of the gel (first mark) or that the position of the bands originating from each of the four wells would be different (second mark).

Q2 This five-mark question was based on an electron micrograph of a section through a series of neurones. Most candidates could identify X as the myelin sheath and Y as the axon thereby obtaining both marks for Part (a). Part (b) was also usually well answered. Most candidates could answer that the presence of a myelin sheath and a thicker neurone would lead to impulses being conducted faster. Part (c) proved to be more discriminatory. While a significant number of candidates were aware that an electron microscope was involved, only a minority of candidates could extend their answer to add that it was a 'transmission' electron microscope. A surprising number of candidates answered light microscope, showing a lack of understanding of the magnifications and resolutions possible using the different types of microscope.

Q3 The third question on the paper tested understanding and the skills involved when using a haemocytometer. This question proved to be demanding with only a small minority of candidates obtaining seven or more of the ten marks available. In Part (a) (i) only a minority of candidates answered that a type-A square would not be used as there were too many cells to count accurately (too many cells unqualified was not rewarded). More candidates could add that there were many type-C squares empty or that they were too variable. Part (ii) required candidates to calculate the number of cells in one mm^3 and this was usually well done. Part (b) was often well done but a number of candidates were unable to distinguish between a variable that should be controlled when sampling the yeast from the flask and a precaution that should be taken when adding the yeast to the haemocytometer. Part (c) asked candidates to explain why it would be appropriate to use a log scale on the y-axis when plotting the increase of yeast cells over time. Only a small minority of candidates obtained both available marks, often due to poor expression or a lack of detail in their answers; for example, for the first mark it was necessary to state that there would be a 'dramatic or significant' increase/change in population numbers rather than there were 'large numbers' involved (and not stating that there was a large range). Part (d) also proved demanding for many candidates. Very few candidates answered that the small size of bacterial cells would become an issue if attempting to make a visual count on a haemocytometer slide (Part (i)). In Part (ii) many of the more able candidates could suggest that 'turbidity' referred to degree of transparency or cloudiness of the sample – the feature of the sample that controlled the amount of light that could pass through, i.e. the transmission or absorbance value.

Q4 This question required candidates to outline how a named organism could be dissected. This was usually well answered with many examiners reporting that those candidates who appeared to have carried out a dissection in class having a greater knowledge and understanding of the steps involved. The most common dissection described was the leaf scrape but there were descriptions of rat, earthworm and insect mouthparts among other examples used.

Q5 This eight-mark question on the chromatography of plant pigments provided a good range of marks across the candidature; while most candidates scored well in Parts (a) and (b), only a minority picked up a majority of the marks available in Part (c). In Part (a) candidates had to describe how a small concentrated spot could be produced on the origin of a chromatogram. This was usually well done with most candidates picking up the mark for naming a piece of apparatus involved, for example micropipette, although a number lost the second mark for lack of clarity when describing how many spots were involved. Part (b) was also well done with most candidates being able to describe how to calculate a Rf value. In Part 5(c)(i) it was important that candidates understood that their answer should describe a reason for small variations in Rf values among the students' results (factors that could contribute to large variations were not credited). Consequently, answers such as difficulty in determining the exact position of the leading edge or centre of the spot were credited as were answers such as (slight) variations in the saturation of the tank, but not answers such as the spot measured from the bottom rather than the top or vague answers such as incorrect measurement of the solvent front. Part (ii) also proved demanding for many candidates; while many could identify that student D's Rf values were lower that the other students, only a minority could add that although lower, they were in the same sequence. Part (iii) asked candidates to suggest a possible reason for the results recorded by student D. Correct answers involved a reason that could produce both significantly different and lower values across the range of pigments. Answers such as measurement from the base of the spot rather than the centre (or leading edge) were credited, as was incorrect positioning of solvent front or failure to saturate the tank.

Q6 This seemingly straightforward seven-mark question on the respirometer proved more discriminating than expected. Most candidates obtained the two marks in Part (a), appreciating that by covering the living material with foil, photosynthesis could be prevented and therefore ensuring that only gas exchange involving respiration was taking place. For Part (b), candidates had to calculate the RQ value of the peas and this proved very demanding for many candidates. While many could obtain the correct value for the oxygen consumed over the 24 hours (Part (i)), a much smaller proportion of the candidature could calculate the carbon dioxide (and therefore the RQ) in Part (ii). A minority of candidates lost a mark through incorrect rounding of the RQ value after correctly obtaining the correct values for the oxygen used and the carbon dioxide produced, and a small number obtained the correct values and then carried out the calculation 'upside down', again losing one of the two marks. This was surprising as the calculation of RQ is a standard requirement in many questions involving a respirometer. In Part (c), more able candidates were able to explain why it was important that the respirometers were kept at the same temperature over the 24-hour period and identify another variable that should have been controlled.

Q7 Estimating animal populations using the capture-mark-recapture technique was the topic for the penultimate question on the paper. Part (a) required candidates to describe how to carry out the procedure and this was well done with most candidates obtaining at least four of the five marks available. As with similar 'recipe' practical techniques in AS3 papers, candidates do well in this type of question. In Part (b) (i) candidates had to describe the trend shown in the graph. Most candidates

could answer that a particularly large fall in the number of marked birds observed occurred between 2007 and 2008, therefore obtaining the second mark. Many fewer candidates picked up the mark for a description of the overall trend, i.e. that the number of marked birds observed fell between 2005 and 2010. Candidates lost this mark through describing the change in number of marked birds observed in each of a series of small sections of the graph rather than over the entire period shown. In Part (b)(ii) candidates tended to pick up marks by stating that births/deaths were not taken into account and/or that immigration/emigration would have taken place. However, only a small number of candidates identified the fact that only marked birds were taken into account and not the total number observed.

Q8 The final question on the paper was a fourteen-mark question testing aseptic technique and statistics. Overall, this question proved to be a very effective discriminator. Part (a)(i) was generally well answered with most candidates obtaining at least four of the five marks available. A small number of candidates seemed to mix up procedures for transferring bacteria from solid (slope) cultures and nutrient broth and there were descriptions of using L-shaped spreaders to obtain bacteria from slope cultures. Part (a)(ii) proved more discriminating with only a minority of candidates being able to explain why Petri dishes are incubated upside down. Part (iii) required candidates to use the information available (in the diagram) and to give one reason against comparing antimicrobial effectiveness using the diameter of clear area or the total areas themselves. In general, this was not well done. Only a small minority of candidates answered that the diameter of each clear area was not consistent and that the total area was not an accurate representation of antimicrobial effectiveness as it was affected by the edge of the Petri dish. Similarly, Part (iv) was poorly answered. Many candidates made reference to E-strips, thus mixing up plant antimicrobial properties with antibiotic testing or made reference to the use of larger Petri dishes or the repeating of the experiment (measuring the diameter in several directions and obtaining an average was credited but not the vague 'repeat the investigation'). In Part (b)(i) candidates whose answer focused on the word 'adaptation' tended to gain the mark as they gave answers suggesting why there could be a difference between root and leaf tissue in antimicrobial properties. Surprisingly, many able candidates failed to pick up this mark. Parts (b)(ii) and (iii) required candidates to calculate the t-value and summarise the outcome of the t-test. In general, the t-test calculation was well done (Part (ii)). Part (iii) was more discriminating with a significant number of candidates unclear over how to determine or express p-values. The understanding of significance and what it means was very variable.

Principal Moderator's Report

Assessment Unit A2 32 Practical Skills in A2 Biology

This was the first year of the new A2 practical work and the work submitted was generally of high quality and matched the requested evidence. The centres have responded well to the new practical requirements and this was evidenced in the work submitted. As with AS work the was great variation in the way work was submitted and in the quantity of the work. Some centres have chosen the route of a comprehensive lab manual with methods and extensive conclusions whereas others chose to simply provide the evidence as requested in the guidance material. In the vast majority of centres it was clear and obvious that the candidates had fully engaged in the practical activity which is the intention of this section of the specification. It is important to remember that a comprehensive review of the practicals will be of great help to the candidates in preparation for the practical exam.

There was some confusion regarding which combination of microbiology practicals could be submitted. This meant some centres had problems when it came to entering marks on the e-moderation platform. A streak plate can be carried out or an investigation into the strength of antibiotics on bacterial growth as one practical. A second practical is the effect of anti-microbials on microbe growth.

Investigating Aseptic Technique

There are two options; isolation of single colonies using a streak plate or investigating antibiotics. In the case of the latter practical the candidates are expected to grow a spread plate (a 'lawn of bacteria') so that the antibiotics can be investigated.

As evidence for the streak plate a drawing or a photograph should be provided showing the isolated colonies and a brief explanation of how or why the technique is used.

If investigating the antibiotics than measurements of the clear zones should be tabulated and a brief explanation of the outcome provided.

Antimicrobial Properties of Plants

A key part of this practical is the preparation of the plant extract. Whilst it is difficult for a centre to obtain many different plant extracts it is possible to buy and use pre-prepared plant extracts. However, at least one of the extracts needs to be prepared by the candidates. Alternatively the one plant extract can be used to investigate the effect of concentration. Evidence can be a photo or drawing of the plate and a table of the measured clear zones.

Investigating Microbial Population Growth using a Haemocytometer

Investigating yeast population growth was a very commonly submitted practical and many centres adapted investigations used in previous A level coursework. It is important that it is an investigation and not just a calculation of population growth. Possible factors for investigation could be effect of temperature, food concentration or oxygen availability.

For evidence, a table of yeast cell counts from the haemocytometer should be given and a population per unit volume calculated. From these results a brief conclusion explaining the results should be given.

Calculation of RQ Values using a Respirometer

This practical did cause some problems in centres mainly due to the inconsistency of the apparatus to provide effective results. It is possible if a teacher/lecturer is able to set up the apparatus successfully then the pupils could take readings from the apparatus and calculate their RQ values. Some centres used a simple respirometer made from a capillary tune and a syringe. Evidence should include a table of results of distance moved by the coloured bead and the subsequent calculation of oxygen and carbon dioxide levels. From this RQ values need to be calculated and reference needs to be made to the nature of the substrate being respired.

Redox Indicators

There were several ways in which this practical was approached by centres; some investigating photosynthesis and some investigating respiration.

Many centres supplemented their table of evidence with photographs of the test-tubes showing the colour changes which have occurred.

If the results don't turn out as expected it is worth while taking a photograph to show the candidates carried out the experiment.

Chromatography of Plant Pigments

This is a standard, common practical which was carried out by most centres. Depending on the leaf used and, sometimes, the time of year, centres identified between three and five separate pigments. The candidates are expected to measure the distance travelled by the spots and RF values calculated from these values. The candidates should try to identify the name of the pigments according to colour, position and RF value. Along with a copy of the chromatogram (or photograph) this is the evidence that needs to be recorded and submitted.

As the spots fade quite quickly it is a good idea to mark on the spots immediately and a good option is to also take a photograph of the chromatogram.

Working with DNA

There are two options of practical work which can be carried out for this category. Extraction of DNA for plant material is a simple and cheap practical which can be carried out effectively in the class in a short space of time. Each candidate (or in pairs) can easily extract the DNA. The evidence should include a brief description of the method and conclusions regarding the reasons behind the stages in the practical. A photograph again is useful as evidence.

An alternative option is to carry out Gel Electrophoresis. Although more difficult to carry out and to obtain the relevant apparatus there are various outside agencies where this technique can be carried out. The Stem Module or W5 offer opportunities to undertake this practical. Evidence for this is a drawing or photo of the separated bands, a brief description of the method and a brief description of the outcomes.

Dissection

There are two options available for this practical category. A small animal, for example a rat (or a heart if not dissected at AS level), or insect mouth parts, for example, a locust. The other option if the others are unavailable is a leaf scrape.

It was good to see many centres carrying out a dissection of a rat and the quality of drawings was of a high standard. Some of these centres included photographs of their dissections which showed the individuality of their work. It was also good to see centres attempt the leaf scrape. It is important the dissections are labelled with the main visible features being named. Again a photograph of the leaf scrape down the microscope is good evidence to show that candidates have carried out the practical task.

It is important that the evidence submitted clearly shows that the candidates took part in the dissection. It is not sufficient to copy a dissection diagram, from the internet for example, and then draw this. This seemed to be the case in some centres.

Overall the new practical tasks appear to have been well received by both teachers and students and it is good to see such a high standard of skills being displayed by the A2 candidates. Marking was generally consistent and fair and the evidence was well presented for moderation.

Contact details

The following information provides contact details for key staff members:

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

COUNCIL FOR THE **CURRICULUM, EXAMINATIONS** AND **ASSESSMENT**
29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG
Tel: +44 (0)28 9026 1200 Fax: +44 (0)28 9026 1234
Email: info@ccea.org.uk Web: www.ccea.org.uk

Rewarding Learning