OCR
RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **A2 H421**

Advanced Subsidiary GCE **AS H021**

OCR Report to Centres

January 2013

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

OCR will not enter into any discussion or correspondence in connection with this report.

CONTENTS

Advanced GCE Biology (H421)

Advanced Subsidiary GCE Biology (H021)

OCR REPORT TO CENTRES

Overview

This is the last occasion when candidates will be able to sit examination units in a January session. This ultimately means that Centres will have a great deal more flexibility in the way in which they teach the specification. It means that schemes of work can be devised that will group together related learning outcomes from different units. It will be essential, however, to ensure that candidates are suitably prepared to identify the learning outcomes that will be assessed in the individual units.

As has been highlighted in previous Reports to Centres, Centres are reminded of the importance of careful consideration of the requirements for the assessment of each of the units when preparing their candidates. The individual requirements vary from unit to unit and are outlined in the table below. Each unit examination, therefore, has a distinctive feel. Candidates should be prepared for the way in which the questions will be asked and the relative weightings of each of the Assessment Objectives.

Unit	AO1 weighting		AO2 weighting		AO3 weighting		Synoptic		Raw mark
	raw mark	%	raw mark	%	raw mark	%	raw mark	%	to UMS
F211	28	46.67	28	46.67	4	6.67	N/A	N/A	60 to 90
F212	42	42.00	48	48.00	10	10.00	N/A	N/A	100 to 150
F214	20	33.33	36	60.00	4	6.67	12	20.00	60 to 90
F215	36	36.00	54	54.00	10	10.00	20	20.00	100 to 150

From this information, it is clear that, if their only internal assessment has been simple recall of facts (AO1), some candidates may well approach the examinations with a false sense of security. It is quite likely that they will score highly in AO1 tests, think that they are progressing well and underestimate the amount of work that they need to do in preparation for the examination. If they have had little or no assessment involving AO2 and AO3 (and, if appropriate, synoptic elements) then when they are sitting the examination they will feel that they are unable to cope with the type of questions with which they are confronted.

One area in which improvement could be made is that of ensuring that the candidates display their knowledge and understanding to the greatest effect by answering the question that has been set, rather than concentrating on a few key words and then losing the thrust of the question. Credit cannot be given for good, correct biology if the candidate is not answering the question.

Teaching Tips:
There are various strategies that candidates can use to ensure that they have answered the question appropriately.
One is the use of the acronym **RE-BUGG**:

- **RE** read the question.
- **B** box the command words.
- **U** underline the key words.
- **G** gauge the number of marks available.
- **G** glance back at the question to check that you have answered all parts of it.

Candidates are expected and required to demonstrate mathematical skills in the examinations. It should be remembered, however, that these will not necessarily have the same format in consecutive papers. In addition to any specific mathematical skills detailed in individual learning outcomes, candidates need to be able to demonstrate other skills, such as manipulating formulae and substituting figures in formulae (see Mathematical Requirements in the Specification Appendix).

The correct use of technical terms discriminates between candidates. Candidates should be encouraged to use the terms appropriately and with correct or unambiguous spelling at both AS and A2. It is expected that candidates should demonstrate an increase in the standard of their use of terminology as a progression from GCSE to AS and A2. Inappropriate terms or those that are more appropriate to GCSE are likely to be ignored, as examiners will be looking for those that demonstrate greater understanding. Terms that should be used with caution at this level include:

‘semi-permeable’ - the preferred term is partially or selectively permeable

‘fair test’ – which is a term that candidates tend to use liberally and inappropriately, when the term ‘control’ or an explanation would be more appropriate

‘dilute’ or ‘concentrated’ or ‘water concentration’ – the term that candidates should be using is ‘water potential’ and explanations are expected to be phrased in such terms

‘message’ or ‘signal’ – candidates should be referring to impulses or the transmission of action potentials

Mention has been made in previous reports and in the reports of the individual units for this session of how candidates should approach the issue of continuing an answer beyond the space allocated. The importance of indicating that the rest of an answer is located elsewhere cannot be understated. This has been mentioned in previous reports and should be emphasised to candidates in the strongest terms possible.

F211 Cells, Exchange and Transport

Examiners were pleased to see that all parts of this examination paper were attempted and that there was no indication that candidates ran short of time. Able candidates were able to score very good mark totals, while all but the very weakest candidates were able to demonstrate their knowledge and score respectable mark totals. However, it is still true that many candidates struggle with the questions testing assessment objective two (AO2). AO2 tests the ability of candidates to apply their knowledge. Assessment objective one (AO1) tests their ability to recall and select knowledge. In this examination AO2 has the same weighting as the more straightforward AO1. It is important that candidates are prepared for questions testing AO2 and expect questions asked in unfamiliar contexts or asking them to apply their knowledge to explain observations or phenomena. The ability to use mathematical formulae is an important skill in biology and candidates should also expect questions that test this ability. Calculating magnifications or true sizes of cells are not the only ways to test mathematical ability.

As in previous series, many candidates who continued responses on the additional pages did not mark their script to indicate that the response was continued. Candidates should be encouraged to mark an incomplete response with an asterisk or a short note to the effect that there is more on the additional pages.

Comments on Individual Questions

Q1 This question was designed to be an accessible start to the examination. Part **(a)** was a general question about the need for a circulatory system and led on to more detailed questions about the structure and action of the heart.

(a) Many candidates were able to state that large mammals are active and have a small surface area to volume ratio. Many also stated that this meant that diffusion would be too slow to supply sufficient oxygen to the tissues. Some candidates, however, gave vague responses about diffusion of 'substances' or 'materials' and failed to state that diffusion was too slow or that the distance was too great for diffusion to be effective. Some less able candidates restricted their responses to the roles of a circulatory system, such as delivering oxygen, rather than to reasons why a mammal needs a circulatory system.

(b)(i) This should have been straightforward and many candidates did gain the mark for stating 'electrocardiogram'. However, there were many variations of the spelling and many candidates stated 'electrocardiograph'. A minority of candidates stated 'ECG' even though the question clearly asked for the full name.

(b)(ii) The majority of candidates knew that **A** was the sinoatrial node and **B** was the atrioventricular node. Again there was a significant variation in spelling and examiners could not accept anything that suggested a link to arteries such as 'arterioventricular node'.

(c)(i) This question asked a familiar topic in a little extra detail. Examiners were looking for the idea that a delay between the excitation of the atria and the ventricles allowed time for the atria to contract and for the blood to fill the ventricles so that the ventricles did not contract too early. Many candidates were able to give suitable responses although the wording of their explanations was not always clear. Candidates should be encouraged to read through their responses after completing the writing. A small number of candidates were not well prepared and gave responses that suggested the valves need time to open and close or that the heart could burst.

(c)(ii) Again, this question asked a familiar topic in a little extra detail. The excitation wave being conducted to the apex of the heart ensures that the ventricular contraction starts at the bottom and therefore pushes the blood up towards the major arteries so that the ventricles can be fully emptied. Fewer candidates were able to score full marks here as many suggested that it allows the whole ventricle to contract rather than starting at the bottom. Quite a few candidates were unable to make the leap from excitation of the walls to contraction and consequently lost marks as they described the excitation starting at the bottom and moving up the walls of the ventricles.

Q2 Part **(a)** of this question tested an individual learning outcome about yeast before testing the use of mathematical formulae in part **(b)**.

(a)(i) Many candidates were able to state 'budding' as the process of asexual reproduction in yeast. However, a lot of candidates gave the response 'mitosis'.

(a)(ii) Most candidates were able to achieve two marks here, usually for stating that a bulge appears in the side of the yeast and it is pinched off. A substantial number of candidates did not read the question carefully or were not aware of the learning outcome about asexual reproduction in yeast. These candidates gave descriptions of mitosis, often naming the stages and describing the movement of the chromosomes in some detail.

(b)(i) Nearly half the candidates gained the two marks for calculating the potential number of new cells produced from one yeast cell. However, a lot of candidates found it hard to transfer their mathematical ability to a biology paper.

(b)(ii) Here, candidates were given the opportunity to consider the assumptions they may have made in calculating the answer to part **(i)**. Many candidates suggested that the scars may be different sizes – even though the evidence from Fig. 2.1 suggested that most if not all scars were of similar size. Other candidates suggested that there was insufficient energy for reproduction – even though they had been told that conditions were ideal. Relatively few candidates could clearly state that there may be space left between the scars that could not be used.

(c) This question was quite straightforward and more than half the candidates achieved full marks. Those that did not gain good marks misunderstood the question and gave quite good responses to other questions such as 'how are cells organised into compartments?' or 'describe how the tissues in the lungs are organised to enable good gaseous exchange'. These candidates were either answering questions from past papers that had been used for focused revision or were using knowledge they had learnt as part of a selective revision programme. It is important that candidates are encouraged not to revise selectively as any and all topics may be tested.

Q.3 This question tested candidates' knowledge about membranes.

(a) As an introduction to the question it was pleasing to see that most candidates knew that membranes are known as partially permeable. Some candidates gave the response selectively permeable which was accepted and a few stated that membranes are semi-permeable. This last was not accepted.

(b) Examiners have observed that candidates often find it hard to complete closed passages successfully. In this case, the majority of candidates fared well and many achieved three of the four marks. The answer that was most frequently incorrect was the third gap where examiners were hoping that candidates would write oxygen or carbon dioxide as all candidates should know that these gases can pass through membranes by simple diffusion. Other responses were allowed such as fats, lipids

and steroid hormones. The fourth gap also caused a number of errors as candidates wrote a variety of responses including 'glyco' to make glycoprotein and 'channel' despite the fact that channel proteins had been mentioned already.

(c)(i) This was a one-mark question and many candidates gave the correct response. However, a good number of candidates attempted to write a long description of how cell signalling is achieved. This sort of response is not required for a one-mark question. The next part of the question asked for a description of how cell signalling is carried out. Some candidates also confused cell signalling with cell recognition.

(c)(ii) This question asked candidates to explain how cell signalling is achieved with emphasis on the role of the cell surface membranes. It was interesting to see how few candidates picked up on the first mark point about the release of signal molecules from a cell. Most candidates, however, concentrated on the target cell and correctly described the role of glycoproteins and glycolipids as receptors. Candidates should distinguish between the terms 'specific' and 'complementary' in their responses. It was often unclear what was specific and what was complementary to what. Examiners would like to see candidates making it clear that it is the shape of the signal molecule which is complementary to the shape of the receptor. Many candidates unnecessarily brought in ideas about cell recognition and cell binding.

Teaching tip: Teachers should encourage students to read through each question before starting to write their answers. In question three a number of candidates offered the same response in parts **(c)(i)** and **(ii)**.

Q4 This question dealt with the familiar topic of transpiration. It proved to be accessible for most candidates and many performed well. Those that performed less well often failed to use suitable technical terms or wrote answers that were poorly phrased and not easy to interpret. This question included marks testing assessment objective three (AO3).

(a)(i) Many candidates gained one or two marks here for suggesting that the student should have provided units in the table of results and could also have given raw results rather than just a mean.

(a)(ii) Most candidates were able to point out that the results showed an increase in bubble movement as the number of leaves increased. Many were also able to link this to an increase in transpiration and an increase in water uptake. There was a minority who tried to link the increased bubble movement to photosynthesis – despite the diagram showing a potometer. Candidates should understand that while photosynthesis does use water, it does not have a significant effect on rate of water uptake compared to the effect of transpiration.

(b) In part **(b)** candidates were presented with some statements from an evaluation of the practical work that had been carried out. Candidates were asked to explain why the factor noted will affect the results and state one improvement that could be made. Many candidates were able to gain marks, although in some cases the explanations were not clearly stated. The idea that larger leaves would provide greater surface area or more stomata was usually made clear and a suitable improvement was to use leaves of similar size. Some candidates did suggest trimming the leaves to size which ignored the fact that the cut edges would have some effect on the rate of transpiration. The second evaluation comment was about the leaves getting wet. In this case a full explanation should include use of the terms 'water potential' or 'water potential gradient'. Explanations that did not include use of such terms were generally too vague. The third statement was about the sun coming out and raising the temperature in the laboratory. Some candidates tried to explain the effect on water uptake in terms

of increased photosynthesis – but again, the main effect is likely to be on rate of transpiration. The suggested improvement should have involved keeping the temperature constant and many candidates achieved this mark, however, some offered more vague responses such as 'keep the conditions constant'.

Q5 Most candidates generally managed well in this question about cell structure.

(a) Many candidates recognised that chloroplasts and cellulose cell walls were found only in plant cells. Most also knew that ribosomes are found in all three types of cell. Fewer, however, realised that centrioles were found only in animal cells. Examiners were concerned by the number of 'hybrid ticks' – the name we give to a tick that is converted to a cross. If candidates change their mind they should completely cross out the old response and write a new one – not attempt to change it.

(b) The science on which Question 5 **(b)** is based is differential centrifugation. Whilst differential centrifugation separates organelles by density, it is not a technique that yields pure fractions of isolated organelles. The sediment or pellets produced by differential centrifugation contain *mixtures* of organelles, and components such as mitochondria, lysosomes and peroxisomes typically sediment out together. It was possible for *more than one type of organelle* to be identified in each tube and more able candidates should have been able to use the information in the table to deduce which tubes contained the organelles listed.

(b)(i) In this question candidates were presented with the results of some tests to interpret. The majority of students were able to work out that tube 1 contained the nuclei, tube 4 contained the ribosomes and tube 2 contained the mitochondria. Many also used the evidence in the table to work out that tube 2 also contained the lysosomes. However, a number of candidates ignored the evidence in the table and simply filled in tube 3 for the tube that contained the lysosomes.

Candidates should be encouraged to read the question carefully and make use of all the evidence provided in the stem of the question.

(b)(ii) Candidates should be aware of the relative sizes of the organelles inside cells and many gave the correct response – however, it was surprising to see some candidates suggesting that the nucleus was the smallest organelle. The majority of candidates who did not score suggested lysosomes as being the smallest organelle.

Q6 This question was designed to be higher demand and, as such, proved challenging for many candidates. However, the more able candidates were able to apply their knowledge and give answers that indicated a good understanding of the topic material. Part **(a)** was designed to help candidates understand that different living organisms often face similar challenges and that these challenges may be overcome using similar solutions. In this case, the role of both lignin and cartilage in supporting tubular structures and keeping those tubes open even when the pressure inside is lower than outside.

(a)(i) Candidates were asked to explain why lignin is essential in the xylem. Many candidates understood that the lignin strengthens the xylem vessel and prevents it from collapsing when transpiration causes tension in the vessel. Many candidates also knew that lignin waterproofs the walls of the cells and kills them producing a long column in which water can travel easily. A good number of candidates also knew that the lignin helps adhesion of the water molecules to the wall of the xylem vessel – but many of those that mentioned this were not able to describe it clearly. Some candidates seemed to believe that the lignin protects the xylem against high pressure and prevents it bursting.

(a)(ii) Here, candidates were asked to explain why cartilage is essential in the trachea. Many candidates could correctly state that the cartilage provides support and holds the trachea open. Few were able to extend their response to explain why this was necessary in terms of reduced pressure inside the trachea caused by inspiration. Many candidates were sidetracked into describing the shape of the cartilage as being important. The shape of the cartilage was often described as a C ring which allows flexibility and swallowing to occur, however, while this may be correct it is not answering the question.

(b) This part of the question asked candidates to comment on the significance of a series of statements about the surface area and volume of the human body. It was intended that candidates would be led into discussing the surface area to volume ratio of the body. However, only the best candidates picked up on this idea. These candidates were able to gain marks for stating that the body surface gave a small surface area to volume ratio which was unable to supply enough oxygen to the blood. However, the large surface area of the lungs gave a large surface area to volume ratio which could supply enough oxygen to the blood. Less able candidates made vague statements about the body having a large surface area to volume ratio or there being a need for a transport system. Few candidates calculated the surface area to volume ratio.

F212 Molecules, Biodiversity, Food and Health

General Comments

This was a straightforward paper that discriminated fairly across the whole range of abilities, although, as with previous January papers, few scripts from very strong or very weak candidates were seen. Questions were worded carefully and lead most candidates unambiguously into what was required of them in answer. Pleasingly, more candidates seem to be noting the command word in the question and addressing what is required. However, many are still not reading the whole question rubric and using this for guidance in their answers.

A number of responses, particularly to the longer questions, were rather jumbled. Candidates are advised to give their answers in as logical an order as possible. The extra sheets at the back of the paper should provide sufficient space for notes that can be sorted into a logical order before answering. It is worth noting that, when using the extra pages at the back, a large number of candidates fail to indicate that they have done so – a simple asterisk or 'continued on back' would suffice. If candidates are going to use a diagram to explain an answer it must be labelled and annotated. This commonly occurred in **6(c)** – where candidates were drawing nucleotides or sequences of nucleotides, but not naming the parts, the carbon numbering or the types of bonds.

There were some problems with the definition of key terms, particularly in question **2**. The difference between an antibody and an antigen should be ingrained at AS-level, as should the relationship between a pathogen and an antigen. Candidates should also be aware that only enzymes have active sites.

One surprise was that the food test question was not done well, and sometimes was omitted. There is value in carrying out these biochemical tests as a class practical.

Comments on Individual Questions

Q1 This was a relatively simple introduction to the paper.

(a)(i) This presented relatively few problems. Around 20% of candidates confused mayfly and damsel fly, although it is genuinely hard to see why. A small minority of candidates put the same answer down for two different insects, demonstrating a lack of understanding about how to use the key, as this should not be possible.

(a)(ii) Candidates were split on their ability to define a dichotomous key. A small majority recognised the significance of only two possible alternative outcomes per question (some stated this as a "yes or no" option, which examiners accepted). Others merely described its role, with responses such as "it identifies organisms on the basis of their features". Some inventive candidates suggested it could be named after its inventor "*Mr Dichotomous"*.

(b) The most popular answer was gills, with a few tails for swimming. Candidates who pointed out the legs needed to qualify their answers as to how this would help them survive in water with some aspect of movement, as legs are a common feature of land-based insects.

(c)(i) Most answers cited a nucleus or membrane bound organelles, but the spelling of 'nucleus' was often poor. Naming any membrane-bound organelle demonstrated knowledge and was also credited. Because examiners were looking for specific features that a eukaryotic cell contains, stating features that are not present in eukaryotic cells was not sufficient, nor was stating that eukaryotic organisms can be multicellular, as the question directed candidates towards features of the cells themselves.

(c)(ii) Candidates had to go on to describe features found in plant cells that are not found in insect cells. Most stated that plant cells have cell walls and many gave chloroplasts as another correct response. 'Chlorophyll' alone was not accepted as this is not a feature per se, merely a molecular substance found within in a plant cell's chloroplast. Candidates who cited vacuoles had to qualify their answers with 'large' or 'permanent', to discriminate them from the small vacuoles found in other eukaryotic cells, and many did not. Statements such as 'autotrophic' or 'the ability to photosynthesise' were not accepted as these are not physical features.

Q2 Generally, candidates performed poorly in this question. It was rare to award full marks anywhere other than the single mark questions. It was surprising how woolly many candidates' understanding of this topic, and some key terms, was. Amino acids and nucleotide bases were often confused, protein synthesis was thought to involve joining up nucleotides to make amino acids, and there was confusion between the terms pathogen, parasite, antibody and antigen. There was also some confusion between binding sites and active sites. Students do not seem to understand that only enzymes have active sites.

(a) This answer was often very muddled. A little over half got more than one mark and a lot failed to score anything. The difference between a parasite and a pathogen is not always easy to explain but it is a learning outcome on the specification and, as such, candidates should have learnt about it and should be expected to have some strategy for answering questions that test it. Most candidates were caught up in the fact that viruses are 'not living'. By far the most common responses were 'pathogen harms the host' and 'parasite lives off the host' – the former applies to parasites as well and the latter does not convey the nature of the relationship – fundamentally a nutritional one. Definitions appear to have been learned verbatim by many candidates and 'deployed' automatically. Some candidates referred to pathogens being single-celled and parasites multicellular, or that pathogens had antigens that triggered antibodies, whereas parasites 'hid' from the immune system. A relatively common response seen was that pathogens caused an 'immune response'. A few mentioned viruses taking over the host cell without specifying the genetic material.

(b)(i) It was disappointing to see so few candidates, less than 20%, gaining full marks on this concept. Both marking points were equally awarded, with 'antibodies' being seen more often than 'lymphocytes'. There was a lot of vagueness about responses to 'foreign bodies' or 'pathogens'. Many gave vague GCSE level responses about white blood cells. Over a third of responses mentioned neither antibodies nor lymphocytes.

(b)(ii) Since a large number of candidates are A2 students re-sitting the paper, it was expected that many would score well on this question as it overlaps somewhat with F215. However, it was not particularly well answered, though it did seem to manage to differentiate across the range of abilities. The command word 'outline' should have indicated that brief statements of the key points would be the best strategy for answering. The best responses followed a clear line of logic and made a series of simple statements to start with along the lines of 'antibodies are proteins', 'proteins are synthesised in the ribosomes', etc. Only the best candidates were able to state that RNA copies a small section of DNA. Many seemed to think it copies the whole DNA molecule and an alarming number seem to think that RNA and/or DNA are polypeptides or are made up of amino acids. Many said that RNA 'carried' a piece of DNA out of the nucleus; though quite a lot did get the idea that RNA itself passes out of the nucleus. Some were clearly confused by the terms 'messenger' and 'transfer'. mRNA was often seen leaving the cell to carry messages to other cells, often plasma cells. tRNA was often called 'transport' RNA and was described as having a role in bringing free nucleotides, carrying mRNA to the ribosome or carrying DNA back to the nucleus.

The idea that something goes to the ribosome was a commonly scored mark as was protein synthesis unless it had been badly contradicted. Quite a few candidates referred generally to rRNA (sometimes at the ribosome) but failed to make it clear that it was part of the make-up of ribosomes. Only the best realised that tRNA carried in the appropriate amino acids. Less able candidates conveyed their misunderstanding that RNA coded for amino acid synthesis, or that RNA detected an antigen.

A relatively common sidetrack that candidates took was to discuss antibody structure, interaction with antigens, or details of clonal selection and expansion. A surprising number said that RNA was involved in DNA replication and cell division. Some candidates seem to think that the role of RNA was to make the plasma cell.

The best responses, from candidates who understood what was going on, gained all 6 available marks in just a few lines. Paradoxically, many re-sitting candidates seemed to perform less well – including too much detail, making mistakes and, at best, wasting time.

(b)(iii) This question differentiated well, as it was uncommon to award full marks, but rare to give nothing. Some candidates seem to think you can use the term 'antigen' interchangeably with 'pathogen'. This is not the case. There were some rather fuzzy answers about how antibodies worked, talking about antibodies binding to antigens, as if antigens were some kind of free-floating entity. Most candidates used agglutination and neutralisation, even if only in derived terms, although some used neutralisation in a generic sense rather than the precise meaning expected here. Common errors were to talk about antibodies (or antigens) binding to active sites or receptors. Very few seemed to appreciate that the antibodies cover the binding sites on the pathogens. However, quite a few candidates wrote about 'antibodies binding to toxins' instead.

There was a range of successful and unsuccessful attempts at producing something phonetic for 'agglutination'. Attempts to describe agglutination were quite often successful, though the commonest error was writing 'clumping *antigens* together' rather than 'pathogens'. Many candidates were able to say that agglutination makes phagocytosis more likely; few stated that the clumps would be too large to enter cells.

(c)(i) Most students got at least half marks for this question. 'HIV patients' and 'pregnant women' were by far the most common responses. However, whilst most students could explain, correctly, that HIV patients have weak immune systems, most did not get the E2 mark as they wrote about the pregnant woman having a weak immune system or passing the virus on to the baby. Some did talk about the mother passing on immunity but only very occasionally was the idea that antibodies crossed the placenta conveyed. Quite a few students described groups of people that are deemed 'vulnerable' in society, for example, the homeless and those living in poverty or overcrowded conditions, for which there were no marks. This was perhaps due to previous TB exam questions.

(c)(ii) Most responses scored a mark for this question, with the most common correct answers referring to the cost of treating ill people, working-days lost, or the idea of a smallpox-type eradication of the disease. Those who failed to score here were usually those whose answers were too close to the instruction 'other than direct effects on health' in the stem of the question.

(c)(iii) The vast majority of candidates came up with a reasonable suggestion. Unqualified references to 'ethical reasons' gained credit here but it was noted by examiners that this response is being written as an answer to many questions and does not seem to display much understanding.

Q3 Much of Assessment Objective Three (AO3) was tested in part **(b)** of this question.

(a) Nearly all candidates got a mark for 'catalysts' with 'inhibitors' and 'globular' the next most frequent correct responses. The idea of 'intracellular' and 'extracellular' did not seem to be well understood; those who got one, around a quarter of candidates, tended to get both. A number of candidates wrote 'int*er*cellular'. 'Metabolic' or 'digestive' were the most frequently given alternatives which were, in effect, direct copies from the question paper.

Examination tip: Candidates should not just repeat or adjust words that are in the stem of the question for an answer – it is unlikely to be credited.

(b) Pleasingly, most candidates had the right idea and showed an understanding of what needed to be done to plan a valid investigation in terms of independent, dependent and control variables. However, many failed to gain full marks because they did not express that understanding using accurate terminology. Most candidates were aware that the investigation should be done with and without the cofactor. However, when it came to describing how the cofactor should be varied, many failed to describe more than two different values and around half of candidates failed to use the term 'concentration', often giving 'volume' or worse, 'amount'. Nearly all candidates showed they understood the need to control other key variables but the frequent use of 'amount' denied many of them access to two more of the potential marks. Also a problem for a minority of candidates was the wording used as an alternative to 'same', e.g. 'known', which only gained credit if it was further qualified. Most candidates were aware that temp and/or pH would affect enzyme activity and so would need to be controlled and most also knew that the dependent variable should be measured after a given time. The majority of candidates showed that they knew repeats were needed but close to half failed to imply a minimum of three. Some weaker responses suggested varying the concentration of rennin – either a mis-reading of the question or a worrying lack of basic science.

Examination tip: In biology, never use the word *amount* in an answer. Similarly the word *different* is very vague. When describing a number of, e.g. concentrations, 'different' does not imply 'more than two'; candidates need to state how many concentrations they mean. Also 'repeat the experiment' is not enough – the implication of at least three repeats is required.

Teaching tip: Get students to plan some simple investigations on easily understood aspects of the specification, where getting the procedure right is not likely to be a problem. Allow students the opportunity to practise using the correct words.

(c) The majority of candidates did not score a mark for this question. The idea of recycling was evident in less than 20% of answers. Many candidates implied that proteins had uses other than enzymes but failed to state it in those terms or made a sub-GCSE level reference to 'growth' and/or 'repair'. A simple example of a non-enzymic use of a protein would have been sufficient but it seemed as if most candidates could not think of one. Despite frequent examples of proteins in the specification the most common correct example was, disappointingly, 'muscle'. Some candidates did not seem to realise that enzymes were proteins while others repeated the stem of the question by saying 'minerals were not needed in large amounts' or 'the body needs a lot of protein'.

Q.4 This question generated a spread of marks and allowed most candidates to access the marking points and demonstrate their knowledge. The three parts of **4(d)** had the highest 'no response' rate on the paper, which was surprising for such a basic skill as carrying out a food test.

(a) All candidates attempted some kind of answer for this question and almost half the responses seen were worth 2 marks. Weaker responses often referred to energy input being sufficient for need or implied that the nutrients are needed in *equal* or *minimum* (i.e. 'just enough') amounts. Listing food groups often gained credit for the second mark but the number of incomplete lists was disappointing as was the number of otherwise complete lists that missed out 'fats'.

Examination Tip: The use of 'etc' to truncate a list rarely gains credit in any answer.

(b)(i) Many candidates gained all three marks and the majority scored at least two. The most common correct answers referred to membranes, thermal insulation, protection of organs, hormones and cholesterol. A small minority of candidates cited the use of lipids in, e.g. camels, as a source of metabolic water. However, the question stem stated 'in the human body' so these responses were not credited. Others ignored the question wording completely and gave 'energy storage' and 'respiratory substrate'. Lack of clarity or precision let some candidates down – unqualified references to 'protection' and 'warmth' were not credited. Some candidates have entertaining ways of spelling 'buoyancy'; those that were phonetically correct were credited.

Examination Tip: Candidates should read the wording of the question carefully and ensure that they select the answer that best fits.

(b)(ii) Candidates seem increasingly comfortable with this topic and many gained full marks. It was pleasing to see precision in some answers with regard to where fats are deposited and the subsequent effects on the lumen of arteries. Weaker candidates could still gain all three marks but only if they spelt the first few letters of atheroma or atherosclerosis correctly, and many didn't.

(c) The quality of answers for his part-question varied considerably and it differentiated well across the ability range. The majority of candidates seem to understand that each row requires reference to one clear aspect of structure and that direct comparisons should be made within each row. However, some students still managed to refer to different structural aspects in the same row while others gave functional answers, e.g. solubility, rather than structural. A number of answers reflected a disappointing lack of precision: common uncreditworthy synonyms for 'fatty acid' were 'fatty', 'hydrocarbon', 'hydrophobic' and 'acid'.

(d)(i) It was felt that the awareness of food tests among the candidates was weaker than expected. There were a significant number of incorrect responses: ethanol, Biuret, Benedict's and iodine were seen frequently. The grease mark test was seen once.

(d)(ii) Students who had mis-identified the test in part **(i)** were sometimes able to gain marks here for describing shaking or adding the sample to water. Those who had correctly identified the emulsion test almost always went on to be awarded at least two marking points.

(d)(iii) The majority of answers gained a mark. Nearly all candidates who had mentioned ethanol in parts **(i)** or **(ii)** were able to suggest an appropriate colour or appearance. However, some denied themselves the mark by referring to the white substance as a 'precipitate', perhaps reflecting a general confusion about food tests.

Q5 This question tested a wide range of skills and knowledge. Many responses were reasonably well written, making good use of the available space, with the correct use of scientific terms when required.

(a) The majority of candidates were able to point out that there were still areas to explore or species to discover but many failed to gain a second mark by discussing speciation, which demonstrated a lack of understanding of the time-frame involved. The other correct responses that were commonly seen were that microorganisms are too small to see or that two species had been mistakenly classified as one.

(b)(i) Most candidates demonstrated familiarity with the style of this graphical interpretation question, confidently using data to good effect. It was disappointing to note that a significant minority struggled to describe the numbers of both groups remaining level, with terms like 'parallel' or 'having the same gradient'. The weakest candidates described each line separately, with rambling accounts of every change in gradient, and then found themselves with little space to make a comparison with the other group and so failed to gain full credit.

(b)(ii) Most gained both marks, though a minority were just outside the acceptable range, frequently because of incorrect reading(s) taken from the graph. As ever, some candidates had not read the question stem carefully and lost a mark by failing to round to a whole number.

(b)(iii) This part question seemed to inspire many to start rambling because they had to think of a suitable response, rather than simply state something they had learnt. Inevitably then, it wasn't all that common for both marks to be achieved, though a majority got one. Again, 'speciation' was quite commonly suggested. The best candidates structured their answers clearly, with concise ideas that made good use of time.

(c) It seems that candidates are relatively unfamiliar with this learning outcome on the specification. It was quite rare for a mark to be awarded.

(d) This was the second time that this learning outcome has been tested. However, as this was the first time that the Rio Convention has featured on a paper, it was not surprising that many candidates seemed to have a clearer idea of CITES. However, once the first marking point had been awarded, very few responses referred to a distinct second answer. Some candidates missed out on a second CITES mark by omitting to mention wild populations. Amongst poorer responses, it was disappointing to note that 'trade' was so often missing. In the Rio convention section it was clear that some centres had devoted more lesson time to this area than others. A minority of candidates were aware of the international cooperation and raising-awareness aims of the convention but very few mentioned the word 'sustainable'. The novelty of the Rio convention with students can be inferred by the idea that quite a few candidates thought it was concerned with biodiversity in Rio.

Q6 Candidates seemed comfortable with the biological molecules part of the specification.

(a) The correct answer, monosaccharide, was given in a little over half of scripts. Others did not understand (or notice) the words 'group' or 'precise', and wrote 'alpha glucose', 'hexose' or 'reducing sugar'. Around 5-10% displayed a real lack of understanding and wrote 'polysaccharide'.

(b)(i) The vast majority of candidates had clearly learnt the difference between α- and β-glucose and the majority of candidates gained both available marks. Common minor mistakes included inverting groups on the wrong carbon atom or missing H groups.

(b)(ii) In order to gain credit here candidates had to state a feature **and** explain how this feature was related to the function of glucose and many candidates found this difficult. Less than half of candidates gained a single mark and very few got both. Linking solubility to transport was the most common correct answer. The mark scheme was deliberately unforgiving, so those who stated 'small, so can diffuse into cells', without mentioning membranes, failed to gain a mark. It was apparent that at least a quarter of candidates had learned the mark scheme from a similar past question about *glycogen* and, rather than amending what they had learned so it applied to glucose, simply restated the glycogen points.

(c) Despite only being worth 3 marks this question differentiated well between candidates. Most candidates were able to say that deoxyribose joined with a phosphate and a base, although some denied themselves the mark by stating that they were joined by hydrogen bonding. Strong candidates were able to add further detail about which carbon atoms were involved. Many wrote about the role of deoxyribose in the backbone of DNA but surprisingly few stated that deoxyribose formed part of a nucleotide. It was apparent that many weaker candidates are unclear about the difference between a nucleotide and a DNA molecule. Marks were available from a suitably labelled diagram but many candidates drew nucleotides or sequences of nucleotides without labelling them. Too many candidates regurgitated all they knew about DNA, picking up one or two marks along the way but wasting a lot of time and almost never getting full marks.

(d)(i) This was well answered. The vast majority gained at least two marks and most gained all three. A few of the weaker candidates were confused about the long chains and solubility.

(d)(ii) A majority gave a correct response but many wrong answers were seen. Common errors were starch and amylose, but around 1 in 20 candidates wrote 'collagen' and chitin and haemoglobin also featured.

Q7 Responses to all three parts of this question were not of as high a standard as was expected.

(a) This was a straightforward question that was very poorly answered. Only one-third of answers gained a mark. One can only assume that candidates thought the answer related to some piece of knowledge they had somehow 'missed' in lessons and so they attempted to guess, usually imagining some plant related source for the microorganisms involved. Many candidates also discussed the value of plants in producing oxygen with which microorganisms could respire. Specification point 2.2.1 (e) states that candidates should be able to "*explain that humans depend on plants for food as they are the basis of all food chains*".

(b) Most candidates should have found this question straightforward if they had learned a list of points from a textbook or revision guide. High marks were indeed seen in many cases but few scored the maximum 8, which was surprising as there were 21 different marking points. The guidance in the rubric "*consider a range*..." meant that candidates who provided a long list of brief points scored well, while those who considered only a few points in more depth struggled to access high marks. Many candidates wrote six or seven lines on animal welfare issues and were awarded just one mark.

A number of candidates thought mycoprotein provided less energy or protein than animal protein. This may well be true, but it was not considered a 'disadvantage' – people could just eat more. Bullet-pointed lists are often encouraged in this type of question; however, the bullets themselves should contain enough information for a mark to be awarded. Attempts at discussing contamination often did not gain a mark

because candidates failed to explain the source of the contamination and why it was more likely in mycoprotein.

(c) This question discriminated well. A little over half of candidates are aware that freezing interferes with enzymes but a large proportion of these think that enzymes are denatured or stop working entirely. Some, usually stronger, candidates mentioned removing available water. Discussion of pickling gained a mark in around half of responses. Some contradicted a potential mark, however, with a reference to *high* pH. A significant number of candidates seem to think pickling removes available water, perhaps confusing it with salting. Very few candidates, perhaps less than 10%, seemed aware that irradiation damages DNA. More detailed answers tended to refer to denaturing proteins or microwaves heating up food. Many just wrote 'kills bacteria', which, although true, is not much of an explanation.

Q8 Candidates were required to use their knowledge in the field of biodiversity to either state terms from definitions or provide definitions for terms. This proved to be surprisingly good at discriminating between candidates of differing ability.

In providing definitions, for *speciation* examiners were looking for descriptions that included the emergence of a new species, which was provided by around half of candidates. Some candidates thought speciation was merely a method of defining or classifying different species. Large numbers of candidates referred to the 'creation of a new species', which was accepted on this occasion, but such a sloppy use of language is not really to be encouraged.

For *Adaptation*, examiners wanted candidates to state a feature, characteristic or variation that enables *survival*. Merely repeating the term, for example, "the animal *adapts* to survive" does not define the term. Insufficient detail hampered some candidates, with comments like "making animals more suited to their environment".

Providing terms generally proved to be trickier than describing them. Many candidates omitted 'continuous' from *continuous variation* but almost half of candidates gained the mark.

Binomial was less frequently correctly identified. Many candidates provided an alternative description, such as "naming nomenclature" or "method of classification".

Most candidates managed to identify that seed banks are a method of *ex situ* conservation, but a minority confused this with "*in situ*".

Relatively few candidates identified the *Environmental Impact Assessment.* Some, who did appear to understand the term, got the wording wrong, using terms such as "survey" instead, and were not credited. *EIA***,** when used, was occasionally expanded into an incorrect term and the mark was not awarded.

F214 Communication, Homeostasis and Energy

General Comments

Some excellent answers were seen and those candidates who had been well prepared (with reference, in particular, to AO2, AO3 and synoptic material) performed well.

As noted in previous reports, it is very important for candidates to indicate clearly if their answer extends beyond the boundary of the lines/space allocated for the answer and also to indicate where the rest of the answer is to be found. Some candidates are still neglecting to do this. Candidates should also use any lined pages at the end of the paper for additional answers in preference to additional sheets or booklets.

Crossing out continues to be highly evident and candidates should be reminded that they should pause and think before they begin writing. The extra 15 minutes for answering the paper makes a difference and evidence indicates that candidates have enough time to complete the paper.

In some cases candidates misinterpreted the requirements of the question and, while providing accurate biological information, did not answer the question. This was particularly noticeable in question **3(c)**. Candidates are reminded of the need to read the questions carefully as the demands of the questions are not necessarily direct recall of facts but may be applied to a particular context.

Teaching tips:
Matching pairs games are useful for reinforcing definitions.
When dealing with longer processes or concepts (as, for example, **Q1(b)** and **Q3(c)**) a sequencing or a loop game can be used.

The chemiosmotic hypothesis was assessed in question **5(b)**. OCR will be producing further clarification and an update on this topic in the near future to assist with teaching and learning.

Comments on Individual Questions

Q1 This question was designed to be an accessible start to the exam. Part **(a)**, however, proved to be challenging to some candidates.

(a)(i) It appears that many candidates are more familiar with the structure of the motor neurone than the sensory neurone. Consequently, there was some confusion with the labels for the axon and the dendron – with the terms either being reversed or both regions of the cell being labelled as the axon. Some scripts had been annotated by candidates to indicate that they thought that the label lines were pointing to the same structure. They failed to realise that the region of the cell carrying the impulse from the receptor cell towards the cell body is given the term dendron, while that region carrying the impulse away from the cell body is given the term axon. The dendrite was also misidentified, but by fewer candidates.

(a)(ii) Most candidates appreciated the significance of the arrow, although some failed to indicate that this represented the *direction* in which the action potential was travelling. Few gave the less technical terms of ‘signal’ or ‘message’, which is an improvement on previous sessions.

(b) This part of the question discriminated quite well, with the QWC mark being quite difficult to obtain unless the candidate had written a clear and precise account. Some candidates thought that there were separate sodium and potassium pumps in the membrane and did not emphasise the fact that the pump was an active process requiring ATP. It was not uncommon to see accounts where candidates did not indicate that the ions were being moved into or out of the neurone, simply stating 'in' or 'out' and, in some cases, referring to into or out of the membrane itself. Those who referred to Na^+ or K^+ throughout generally did not refer to 'ions' for one of the QWC terms and a significant number of candidates referred to sodium or potassium throughout. Some demonstrated confusion with the use of the ion channels, interchanging them with the role of the pump. It was a common misconception that the membrane is totally impermeable to sodium ions, while the sodium ion channels that are not voltage-gated are open but allow fewer sodium ions to pass through than the potassium ion channels do for the potassium ions. The idea of the build-up of positive ions outside the cell was often missed, with candidates simply quoting figures for the resting potential.

Some candidates missed the point of the question and gave detailed accounts of the events of depolarisation.

Teaching Tip:
An easy way to remember the direction and number of the ions:
3 Na+ out (**Na+** involves 3 letters/symbol and **out** is 3 letters and there are 3 ions moving out)
2K+ in (**K+** has 2 letters/symbol and **in** is 2 letters and there are 2 ions moving in)

(c)(i) This was the easier part of the question and candidates generally answered this correctly.

(c)(ii) As with **(i)**, this was also well known.

(c)(iii) This question proved to be quite a good discriminator as, even though many were awarded at least one mark, weaker answers failed to give complete explanations. It was not uncommon for candidates to omit reference to the threshold potential when commenting on the strength of the stimulus required to initiate an action potential. Some had an erroneous concept of cause and effect – making such statements as 'the size of the action potential has no effect on the strength of the stimulus'. Despite having been given the phrase 'strength of stimulus', both on the graph axis and in the question, candidates referred to the size of the stimulus and, inappropriately, to the strength of the action potential. Despite the fact that the action potential curves were identical and the time between them was constant, some candidates incorrectly referred to a more rapid response and depolarisation with a stronger stimulus.

Q2(a)(i) This question was well-answered by candidates, with the vast majority being able to state urea as the excretory product produced and the kidney as the organ which would remove it, although references to the bladder were also credited. There were occasional incorrect references to urine as the product and the gall bladder or liver as the organ.

(a)(ii) This question was a good differentiator as it required candidates to apply their knowledge. Some candidates appeared to miss the comparative thrust of this question. They focused, instead, on reasons why lactate needed to be converted to pyruvate in the first place rather than on why this should happen in hepatocytes as opposed to muscle cells. Answers that only referred to the toxicity of lactate to muscle cells, therefore, gained no credit. Similarly, answers that discussed the usefulness of pyruvate in respiration or in the formation of glucose or glycogen failed to pick up the mark.

The most common mark point awarded was for a reference to the liver cells having the correct enzymes. Some candidates attempted to name the enzyme, sometimes incorrectly (for example, pyruvate dehydrogenase), but many appreciated that the required enzyme would be lactate dehydrogenase. Few candidates suggested that liver cells would be more tolerant of low pH and many gave vague answers about the liver being adapted to cope with toxins. Some candidates suggested that liver cells would have more oxygen available than muscle cells to metabolise lactate, but very few stated that conversion of lactate *requires* oxygen and so did not gain the mark. Some responded from a muscle cell point of view, providing creditworthy answers.

In general candidates who failed to score here did so because they gave general or vague answers:

e.g. stating that hepatocytes were better at metabolising lactate, without actually explaining how

providing statements such as 'it's the liver's job to clean the blood' or 'liver cells are specialised for it' which could clearly not be credited without further qualification.

(b) The majority of candidates gained either 1 or 2 marks in this question. There were many good explanations as to what may happen to a person if the liver did not break down insulin. However, although many understood the action of insulin in the normal control of blood glucose, some failed to gain the mark as they did not stress that if insulin molecules were not broken down that this process would *continue* and blood glucose would fall *too* low and cause coma or even death, many merely stating that fatigue or drowsiness would result. Nevertheless, more able candidates understood that hypoglycaemia would result from excess removal of glucose from the blood and/or its continued conversion into glycogen, and many went on to comment that less energy would be released or insufficient ATP would be generated since less glucose would be available in the blood. Some implied that eventually there would be reduced respiration rates but they often did not expand on this by suggesting there would be a consequent lack of energy / ATP released. It was pleasing to see some excellently argued answers, however, including several that went on to discuss other valid points such as desensitisation of receptors and triggering of glucagon release. Some candidates thought that the level of insulin would continue to build up, rather than realising that it would remain stable.

(c)(i) The consequences for liver metabolism resulting from regular high alcohol consumption proved to be difficult for many candidates. There were many general descriptions, often using the bulleted points with little extra detail added to show understanding as to the impact of the information they had been given. Many candidates did not make the link between how reduced NAD had these effects and that a lack of (oxidised) NAD would lead to a reduction in metabolic reactions, such as the respiration of fatty acids. However, many got the idea of fats building up to form "fatty liver", but some thought this led to obesity. Few linked the build-up of lactate with a reduction of pH and the effect on enzyme activity or commented that pathways that they had been given in the stem of the question, such as the ornithine cycle, would not occur.

(c)(ii) The precise location in the liver cell where excess reduced NAD would be re-oxidised was generally well answered, although some candidates did not provide the specific detail that is required at this level as 'mitochondria' alone is not sufficient. Common errors included 'matrix' or 'cytoplasm'. A surprisingly high number failed to read the question fully and didn't see the reference to 'in the cell'. Therefore some candidates gave incorrect answers such as 'hepatocyte', 'sinusoid', 'hepatic artery', or even answers not associated with the liver such as 'thylakoids' or 'Islets of Langerhans'.

Q3(a) Many students unfortunately failed to gain marks here because they gave quite low level responses. They had not learned the correct and full explanations of the two terms. Answers such as 'autotrophs can make their own food' clearly do not match expectations of understanding at this level. Some students were muddled in their use of the words 'organic' and 'inorganic'; others talked incorrectly about 'energy production'. On rare occasions candidates confused the two terms, writing about heterotrophs being able to synthesise organic molecules from inorganic ones. A common error was to fail to explain that heterotrophs *have to* rely on organic substances from other organisms. For those students who had learned definitions carefully, however, this was a straightforward question.

(b)(i) Most candidates scored full marks for this question. A few candidates thought that the stroma was cytoplasm and a few misidentified the granum as a thylakloid.

(b)(ii) Not many candidates were able to gain this mark. The most common incorrect response was to state that the fat store would be used as an energy source for respiration, indicating that the candidate was confused between the roles of the chloroplast and the mitochondria. As the ATP required for the Calvin cycle is generated in the light dependent stage rather than by respiration, this was not considered to be a suitable response. Some candidates suggested that the fat store could be used to synthesise proteins or enzymes. Of those who had the correct idea of membrane synthesis, some lost the mark by referring to the cell surface membrane.

(c) The thrust of this question was light harvesting, Fig. 3.2 representing the light harvesting system on the membrane with the arrows indicating the transfer of light energy to a central pigment. However, many students seemed intent on sharing all the knowledge they had about photosynthesis, including detailed answers referring to the ETC. Many candidates knew that photosystems consisted of different pigments although these were sometimes subsequently confused. Some candidates, for example, thought that both chlorophylls a and b were primary pigments. Specific language also let students down. It was necessary to refer to 'light energy' or 'photons' being absorbed by pigments, not just 'light'. It was also necessary to say that this was 'absorbed' and was not just 'hitting' or 'striking' the pigments. Some went on to say that electrons were passed on from pigment to pigment rather than the light energy itself and failed to get credit as a result. Quite a large number of candidates appreciated the role of the different pigments in absorbing a range of wavelengths. Students should be advised to write clearly when answering questions where spelling of terms is important. The mark for QWC here was sometimes missed due to hurried writing of e.g. 'chloropyll' or 'acessory'. The QWC was more commonly awarded here than in **Q1(b)**. Of those who did answer in terms of pigments, most obtained the QWC mark by referring to primary and accessory pigments, wavelength and chlorophyll a. Candidates frequently gained credit for describing the arrangement of pigments in a photosystem, although the antenna complex was rarely mentioned. Many stated that the accessory pigments "reflected light" or passed "wavelengths" on to the primary pigment rather than transferring energy. Confusion between photons and protons was evident in several answers.

(d)(i) Candidates generally performed the calculation well and gained both available marks. There were, however, occasional slips in the calculation of the percentage. Some gave positive figures as answers and could, therefore, only achieve a maximum of one mark. The most common error was to divide by the wrong figure giving an answer of -8.0% or -7.9%. If the number of decimal places required in the answer is not specified in the question, candidates should be reminded to look at the figures already given in order to judge the correct number of decimal places required.

(d)(ii) Although many candidates were awarded this mark, some were not - for a variety of reasons. Some said that the result was simply an anomaly or too large a difference; some said that there was too great an imbalance between numbers of plots that were treated as opposed to untreated; others appreciated that the small sample size was a problem but then failed to qualify 'small' in a way that implied it was 'too' small a sample.

(d)(iii) Most candidates had correct ideas here and some excellent answers were seen. Some, however, missed out on marks. Candidates were expected to refer to non-cyclic or cyclic photophosphorylation. They often referred, for example, to non-cyclic or cyclic 'phosphorylation' or 'photosynthesis' or to 'oxidative phosphorylation'. Others made the mistake of writing about reduced NAD rather than reduced NADP. Some did not appreciate that reduced NADP could not be formed and focused only on the lack of ATP for the light independent reactions.

Teaching Tip:
Candidates can be encouraged to remember that NAD**P** is involved in **P**hotosynthesis, while it is NAD in respiration.

(d)(iv) This was a tricky question for candidates, aimed at the most able, and few managed to gain the mark. Most, however, to their credit, made an attempt at a reasoned explanation. A common misconception was to say that the herbicide must have been radioactive whilst others went down the route of photorespiration being responsible. The link between energy losses as heat along food chains seemed to influence some of these answers. This is a practical that could be carried out in centres.

Q4 This question discriminated between candidates as it required a clear understanding of processes and terms. As stated in the question stem, and in previous examiner's reports, the terms in this question are frequently confused and often used interchangeably. The phrasing for parts **(b)** to **(c)** indicated that more than one answer could be required and a common reason for not awarding these marks was that only one correct answer was provided.

(a) Almost all candidates answered this correctly.

(b) Correct answers were generally given, although a significant number of candidates only supplied the name of one of the two hormones.

(c) Glycogenolysis and glycogenesis were confused by some candidates.

(d) A significant number of candidates suggested 'negative feedback' as an answer, but this was not creditworthy. Some neglected to realise that, by concentrating on blood glucose regulation, glycolysis also had glucose as a starting point.

Teaching Tip:
Concentrating on the parts of each term will provide a clue as to the nature of the process concerned:

glycogeno**lysis** = **lysis** (breaking down) of **glycogen**
glyco genesis = **genesis** (creation) of **glycogen**
gluconeo**genesis** = neo**genesis** (creation from new molecules) of **gluco**se

Q5(a)(i) Most candidates appreciated that both the adenine and the row of three phosphates were attached to the ribose molecule. The nature of that attachment, however, was less well understood. The row of phosphates should have been attached to carbon five, represented by the vertical line on the ribose molecule, and it was frequently the adenine that was drawn in that position. Adenine should have been attached to carbon one, although if a vertical line was used this was considered to be ambiguous and so not credited.

(a)(ii) Many candidates answered this correctly. The most common incorrect answer was 'phosphorylation', which does not describe the removal of the phosphate group but what subsequently happens to that group.

(b) Many candidates showed a good understanding of chemiosmosis.

(b)(i) Many candidates gained this mark.

(b)(ii) This part of the question proved to be more challenging for candidates. Few seemed to be willing to suggest 'none', even though prompted to do so by the question.

(b)(iii) As there were two possible answers to this question, the opportunity for candidates to score was greater.

Q6(a) Maximum or near maximum marks were commonly awarded. The response 'blood' was not sufficient for gap 1. For gap 2, many did not take account of the term 'small molecules' and gave 'ions' or 'salts' as an incorrect answer. 'Ultrafiltration' was almost invariably suggested for gap 3. A significant number of candidates thought that most amino acids were reabsorbed in the proximal convoluted tubule, whereas they are all reabsorbed there. 'Plasma' was a common incorrect suggestion for the last term.

(b)(i) Many candidates answered this well, with medulla oblongata and pituitary being the more common incorrect suggestions. Some candidates incorrectly tried to qualify their correct answer of hypothalamus.

(b)(ii) Many candidates also answered this part of the question well. 'Osmoregulatory' was not considered to be creditworthy.

(c)(i) As might be expected, the most common incorrect answer was the adrenal medulla. Some random answers such as 'endocrine gland' or 'gall bladder' were also seen. The specification requires candidates to be aware of the roles of both parts of the adrenal gland.

(c)(ii) In order to answer this question successfully, candidates needed to appreciate that the sodium ions that were taken up from the filtrate would enter the blood plasma, thus reducing its water potential, and to indicate this clearly in the answer. They also needed to refer to an *increase* in secretion of ADH rather than simply stating that it would be secreted.

(c)(iii) Most candidates answered this correctly.

F215 Control, Genomes & Environment

General Comments

This was an accessible paper with many candidates scoring high marks in the eighties, and a higher mean mark than seen in previous sessions. The style of questions required plenty of assimilation of question material and thinking, but a little less explanation in prose, which allowed weaker candidates to show what they knew and understood more readily.

Examiners were pleased to report that only a minority of candidates continued their answers on the back page without giving sufficient indication of this to the examiner, though the few who ignored the extra page and used additional sheets unnecessarily made marking more difficult. Candidates should be asked to use the additional answer space at the back of the question paper first and to clearly indicate which answers continue in this space.

It was noticeable that many candidates ignored the QWC instruction on both extended answer questions. The attention of students should be drawn to the special requirements of this type of question. Synoptic questions proved more of a test than recent F215 material, as ever, and questions relating to AO3 practical scenarios also tested many candidates.

Comments on Individual Questions

Q1 This question required candidates to apply their knowledge of classical genetics to an example of sex linkage where the male is the homogametic sex and the female the heterogametic sex. Knowledge of genetic terms and epistasis was then tested.

(a) Most candidates recognised that the feather colour inheritance pattern described was an example of sex linkage. A minority gave incorrect responses such as epistasis or co-dominance.

(b)(i) Candidates applied their knowledge to the information given in order to state the adult colour phenotypes and the sexes of the three genotypes. Most gained three marks but a small minority omitted the sex of the birds.

In part **(ii)** a pleasing number of candidates set out their answer clearly with the correct allocation of alleles to the Z chromosome. Candidates who lost marks often did so because of carelessness in transferring information from parents to gametes and then to the F1 genotypes. A minority reverted to using the more common convention of the female being homogametic and the male heterogametic. Some made the question more difficult by failing to separate the gametes clearly (for example by circling them) and in the case of the non-barred male parent, showing several identical gametes rather than just one. Despite the instruction to give the chick phenotypes being emboldened, a number of candidates gave the adult phenotype instead. It is essential that candidates read the question carefully.

(c) In part **(i)** many candidates gave as their complete answer either the term ‘homozygous’ or ‘recessive’, whereas both descriptors were required for a precise answer. Other common incorrect responses were epistasis and co-dominance.

In part **(ii)** many used their knowledge of epistasis to reason out the correct answer, all white, but wrong answers included white and barred or ratios of different colour combinations.

Teaching tip: If candidates are taught the convention of drawing circles around gametes when setting out genetic crosses, this has the benefit of clearly differentiating each gamete genotype from the diploid parental genotype, and from other gametes.

Q2 This question tested an integrated understanding of evolutionary and ecological principles in the context of the Galapagos Islands.

(a) The most common scientific term awarded credit was 'geographical isolation'. Attempts to describe reproductive isolation were often made, but many candidates did not make clear which of two correct scenarios they were describing, either a lack of interbreeding between populations of the same species on different islands in the early stages of speciation, or the development of other pre- or post-zygotic reproductive isolating mechanisms later to give two species which could no longer interbreed. Many students correctly pointed out that there would be different selection pressures on different islands, but some only considered a difference between the islands as a whole and the mainland, which did not score. A few students mentioned the term genetic drift, but this was only credited in the context of its effects being greater in small populations such as those on the islands.

(b)(i) Candidates found the percentage difference calculation more difficult than in previous sessions, perhaps because the final answer exceeded100%. Many started well by finding the difference between the starting and final figures, but then divided it by the final figure, 125 000, instead of by the starting figure, 16 000. An incorrect answer of 781, obtained by dividing 125 000 by 16 000, was also common. Those who did perform the calculation correctly usually followed the rubric correctly also and rounded to the nearest whole number.

Part **(ii)** gave candidates the opportunity to draw together knowledge of ecological principles such as predation, competition and conservation within the context of the Galapagos. Most candidates came up with some creditworthy ideas relating to destruction of habitats, effects of introduced species and overfishing, but many did not follow the QWC instruction to name case study species. General references to 'litter' (rather than 'increased pollution'), 'diseases' (rather than 'introduction of new diseases') and 'boats having an effect' (without a specific description) did not score. Some students filled the space but gained few marks because they repeated the same point several times. Students would benefit from practising writing extended answers which concisely cover a range of relevant points.

(c) Most students gained a mark for an economic problem, usually linked to reduced tourism or job losses. Few students gained credit for an ethical problem, with the commonest answer being that 'all animals have a right to life'. In order to make a valid point about the ethics of culling animals, candidates need to consider the stress and suffering imposed by culling or forced removal methods, and to balance the need for conservation of other species.

Teaching tips: Candidates often struggle to express maturely considered opinions on questions pertaining to the ethical treatment of animals. Similar questions and their marking schemes for guidance can be found in the January 2011 (monkeys) and June 2011 (hedgehogs) papers for practice.

Q3 This was set in the context of a student doing work experience in a zoo and noting examples of animal behaviour. It required the candidates to match a description of observed behaviour to the type of behaviour. It was generally well answered, with the majority of candidates scoring 5 or 7 marks out of 7.

The most common error was to confuse taxis (movement **towards or away** from a stimulus) with kinesis (**non-directional** movement in response to a stimulus). The examples described are ones that the candidates themselves might have observed. Less common was confusion between habituation (**gradual decline** of a response to a stimulus resulting from **repeated exposure** to the stimulus) and operant conditioning (behaviour is increased or decreased through positive or negative **reinforcement**).

Teaching Tip: Candidates need to be familiar with the various types of behaviour: applying the list of behaviour types detailed in the specification to examples of behaviours seen in television programmes would encourage discussion and the learning of definitions.

Q4 Specification topics covered in this question included causes of genetic variation, reproductive cloning, decomposition, plant growth regulators and the principles of experimental design, all linked to the biology of rhubarb plants.

(a) Most candidates realised that meiosis was the source of genetic variation during gamete production. Both crossing over in prophase 1 between non-sister chromatids, and the independent assortment of chromosomes in metaphase 1, were well described, resulting in a high scoring section for well-prepared candidates. Mutation was often quoted as another source, but random fertilisation was rarely described clearly enough to gain credit. Success on this question correlated well with overall performance on the paper as it required extended writing and use of specific factual details.

(b)(i) Stating the biotechnological term for the propagation of rhubarb by dividing rhubarb crowns proved difficult for most candidates. Candidates did not pick up on the idea of a biotechnological term, and although a few correct references to cloning were given, these were rarely qualified with 'reproductive'. Common incorrect responses referred to taking cuttings or tissue culture.

(b)(ii) Most candidates were able to name the modern technique of producing large numbers of virus free plants as tissue culture or micropropagation. Although the process would produce clones, references to this alone were insufficient here.

(b)(iii) The references to temperature in the stem of the question led most candidates to gain two marks by suggesting differences in enzymes and the possibility of their activity varying at different temperatures. Other correct suggestions commonly given were differences in genes or hormones. Candidates must make sure they answer the question as a few responses here failed to refer to any differences between the two varieties of rhubarb.

(c)(i) Despite the question stating that candidates should investigate how the variety of rhubarb affects the oxalic acid in the leaves, a significant number of responses described a method for varying other factors, such as plant age or environmental conditions. Most descriptions included experimental detail and measurements made, but many failed to gain the QWC mark as there was no indication as to which the independent, dependent and controlled variables were. Candidates would do well to re-read the question after responding, particularly the QWC instruction, to make sure they have included all the necessary detail.

Descriptions usually included the use of several varieties of rhubarb (species was not correct here) and most referred to controlling age and a variety of environmental factors. Making an extract from the leaves in water or alcohol often failed to gain credit

as vague references to 'amount' were common, rather than 'volume' for the solvent or 'mass' for the leaves. Similarly most were measuring 'amount' of oxalic acid instead of 'concentration'. Measuring methods usually involved a pH probe or meter, universal indicator or a titration, although not all candidates seemed confident with describing a method of measuring acidity.

(c)(ii) Many candidates were able to describe decomposers using enzymes to externally digest leaves or they used the term saprotrophic. The absorption of the products of digestion was less often described and the formation of ammonium ions or compounds was frequently confused with incorrect references to ammonia, nitrates or nitrites instead. Decomposer species of bacteria should not be confused with nitrogen fixing or nitrifying bacteria but many candidates have no clear idea of the different roles of these bacteria in the ecosystem.

(d) Most candidates knew that auxin was the plant growth regulator involved in the upward growth of shoots and some correctly linked it to cell elongation. Candidates consequently scored quite well on this question, despite not always really applying their knowledge to answer the question asked. Many described the phototropic response to unidirectional light. The best-performing candidates used this knowledge of the phototropic response to suggest that in the dark more auxin would therefore be present, or that it would be evenly distributed since it had not been destroyed by the light on one side.

Teaching Tips: Candidates should be encouraged to imagine how the quantity they are referring to would be measured, e.g. volume of a liquid, mass of a solid, length of time, etc, as a more specific alternative to using the catch-all term 'amount'.

Q5 This question aimed to test understanding of some elements of the biochemistry involved in the control of the growth and development in organisms. It integrated knowledge of the *lac* operon in bacteria with mammalian control systems such as hormonal control by insulin, the cAMP second messenger system and the operation of homeotic genes and their products in **(a)**. Some parts of the question were quite high scoring, in particular part **(c)** which required understanding of the process of programmed cell death. Parts **(a)** and **(b)** were less well answered.

(a) Candidates were asked to complete a table by putting a tick or a cross in each box. Almost all candidates followed the instructions and did not leave any boxes blank. However, a large number used hybrid ticks in one or more of the boxes and therefore ruled themselves out of being awarded a mark. The biochemical identity and interactions of insulin were slightly better understood than any of the other control elements. About half of the candidates were correct in their answers for cyclic AMP and the *lac* I gene. Less than half knew the correct answers for the *lac* O gene and the homeotic gene product.

(b) Candidates were asked to describe and explain the difference between the functions of RNA polymerase and DNA polymerase. Only the most able candidates scored the full 4 marks. More candidates understood the actions of RNA polymerase and some were able to access all 3 of the marks available for this enzyme. Others went into detail about the role of RNA polymerase in the *lac* operon, obviously linking their answer to part **(a)** of the question, but failing to gain the marks about the basic function of the enzyme in transcription. DNA polymerase marks were picked up less frequently, with many candidates not mentioning its role in DNA replication at all, even within the applied PCR context they will have studied most recently. Very few mentioned semi-conservative replication and although a few mentioned cell or nuclear division they failed to say that replication happens before the division.

(c) The majority of candidates knew the word apoptosis, although spellings were not always correct with the commonest error being *apotosis*. Cytoskeleton was similarly well answered. Most candidates also knew that enzymes were responsible for the digestion of the cytoskeleton components, with some giving the alternative answer of lysosomes. A few incorrectly named liposomes here. Phagocytosis was well understood but both exocytosis and endocytosis were sometimes given as incorrect answers, indicating that candidates had not followed the logic as the question moved from describing intracellular processes to extracellular. Mitosis was usually correctly named and most candidates were able to name the mass of cells as a tumour or cancer. The spelling of the word tumour was often poor and callus cropped up regularly as an incorrect answer for the mass of cells.

Teaching tip: Due to the similarities between DNA replication and transcription and the possibility for confusion between the two processes, it is advisable to revise replication from F212 at the time of first teaching protein synthesis for F215.

Q6 This question covered ideas connected with the harvesting and use of a protein product from genetically modified bacteria grown in a fermenter. The recombinant drug product was then contrasted with the process of gene therapy.

(a) Candidates showed good knowledge of the stages of a standard growth curve, the majority gaining maximum marks for this question. In the few cases where errors were made, most related to candidates misidentifying stage **R**, the stationary phase.

(b) Most candidates were able to explain the term primary metabolite although fewer gained full marks by naming an example. Some candidates lost marks by relating their answer to the batch culture process rather than to processes taking place within bacterial cells e.g. ‘a substance made during the log phase’ or ‘it is the first thing made in a culture’.

(c) Most candidates scored well on these questions. Most identified **Q**, the log phase, as being the time when primary metabolite production was at its highest rate. A small number of unsuccessful responses resulted from confusion between maximum concentration of product and maximum rate of production. Most candidates correctly identified **R**, the stationary phase, as the time when most secondary metabolites are produced, the most frequently given incorrect response being **Q**. Very few candidates failed to gain credit in section **(iii)**, identifying either phases **R** or **S** as a time when the maximum concentration of secondary metabolites would be reached.

(d) The majority of candidates gained full marks on **(i)**. The factors most commonly named were temperature and oxygen followed by nutrients and pH. A relatively small number of responses related to the removal of product or wastes or to the importance of asepsis. Many successful responses suggested increasing levels of oxygen and nutrients, or adjusting to optimum conditions in relation to pH and temperature. Some candidates had not appreciated the need to prevent the denaturing of enzymes and stated that temperature should simply be increased to maximise yield.

(d)(ii) Candidates did well in attempting to distinguish between the use of the bacterially produced HGH as a drug and the process of gene therapy. Two marks out of the three available were commonly awarded. The majority of successful responses recognised that the use of recombinant HGH was not gene therapy as the child’s genes or cells had not been changed. Some then gained further credit for stating that this meant that the child would not be able to produce their own HGH as a result of treatment or that this would not result in cure and that the treatment would need to be repeated. A small number of responses referred to no vector having been used. Candidates should use the information relating to the number of marks available for a question as a guide to the number of statements that should feature in their response.

Q7 This question probed understanding of a variety of modern techniques linked to research goals in medicine.

(a) Most candidates were able to work out the names of the procedures described, often scoring full marks. The main errors were mixing up non-reproductive cloning with animal reproductive cloning or somatic gene therapy.

(b) Many candidates achieved full marks. Most candidates matched goal **C** to xenotransplantation correctly, and similarly goal **E** was linked to the genetically modified vaccine. The most common error was again confusing goals **A** and **B**, reproductive cloning and non-reproductive cloning. Some candidates showed confusion about the non-embryonic or embryonic stem cell manipulation and it is worth highlighting the fact that non-embryonic stem cells are usually taken from the individual who requires the treatment, the purpose being to avoid immune rejection of a transplant.

Q8 Energy flow up a food chain and experimental design principles and data analysis in an ecological investigation formed the subject material in this question.

(a) The candidates were asked to define three terms relating to food chains. Examiners were looking for clear statements describing the main feature that identifies each term precisely. The majority of candidates had some understanding of the terms 'producer' and 'consumer' but a substantial number of candidates found it difficult to formulate their knowledge in the concise and accurate way a definition requires. Repetition of words from the question was a frequent fault. For example, describing a consumer as something that 'consumes organisms' is not a clear and useful definition. Another common error is for candidates to state that energy can be produced or created rather than converted from one form (light) into another (chemical) in producers.

(b) The majority of candidates picked out sensible factors to control in **(i),** the most common being 'volume and concentration of the chemical used' and 'time spent waiting for earthworms to rise' or 'time counting earthworms'. A significant number of candidates used the imprecise term 'amount' instead of volume or concentration and consequently did not score. Some candidates repeated information given in the question, such as 'size of quadrat'.

(b)(ii) Moving on to analysis of the results, good candidates recognised that while there was a difference in the mean values of the two sets of data provided, the error bars reflected such a wide variation in the results that the difference was not clear. Weaker candidates interpreted the error bars as mistakes made by the experimenters and failed to see their significance. Some candidates used the data for 2006 when the question clearly stated 2004. The incorrect use of the term significant difference surfaced occasionally.

Finally a large proportion of candidates knew the meaning of the term 'dynamic' in **(iii)** and made a good attempt to pick out two examples of data. A change from year to year was one clear difference, and other pairs of data showing a change in earthworm abundance under different types of plant cover, or plant cover versus cover removed could also be commented on. The major error was for candidates to describe a trend without any reference to the subject of the data, that is, the abundance of earthworms.

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