RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **A2 H421**

Advanced Subsidiary GCE **AS H021**

OCR Report to Centres

January 2012

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Oxford Cambridge and RSA Examinations

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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.

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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OCR REPORT TO CENTRES

Overview

This was the first session in which an additional 15 minutes has been allowed for each A2 question paper, which contains Stretch & Challenge questions. This change was previously announced via a Notice to centres, see:
http://www.ocr.org.uk/qualifications/type/gce/science/chemistry_a/

Centres are reminded of the importance of careful consideration of the requirements for the assessment of each unit when preparing their candidates. The individual requirements vary from unit to unit and so provide the characteristic features of each unit examination, giving each one a distinctive feel. Candidates should be prepared for the way in which questions will be asked and be aware of the relative weightings of each of the Assessment Objectives, for example, that F211 has a much higher percentage of AO1 questions than any other unit. This has been highlighted in previous Reports to Centres and the weightings of the Assessment Objectives in each unit, extracted from information in the specification, are summarised in the table below.

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 some candidates may well approach the examinations with a false sense of security if they are over-reliant on simple recall of facts (AO1). It is quite likely that such candidates will score highly in AO1 questions, but may underestimate the amount of work needed in preparation for questions that assess application of knowledge (AO2). If candidates have had little or no experience of internal assessment involving AO2 and AO3 (and, if appropriate, synoptic elements), they may be unable to cope with the range and types of questions with which they will be confronted in the live examination.

Teaching Tip:
Give your candidates some progress tests that only assess AO2 and AO3 so that they can have a better idea of how they perform in these types of questions and the amount of preparation that they need to do in this area.

Although the specification is subdivided into units, the ethos of the specification is *not* that the individual learning outcomes should be taught in isolation. Candidates are expected to develop ideas, themes and draw links from different areas of the specification. In this session, for example, question **6(a)** in **F211** required candidates to give roles of membranes *within* cells. This was not well answered by many candidates, perhaps because the question was misread or because this aspect of the learning outcome had not been covered as thoroughly. This aspect of the learning outcome is very important as it provides the foundation for the whole of A Level study, in particular being the basis of knowledge and understanding for **F214**.

Command words proved to be a problem for a significant number of candidates. A list of the command words commonly used in assessment can be found in the Practical Skills Handbook, together with the features of the answer required for each command word. Candidates should be familiar with these so that they do not waste time and effort in providing unnecessary or inappropriate information in their answers.

The correct use of technical terms discriminates between candidates. Unscientific language and using inappropriate or incorrect terms can mean that marks are not awarded or that the Quality of Written Communication is not awarded. Candidates should be encouraged to use the terms appropriately and with correct, unambiguous spelling at both AS and A2.

While past papers can be a useful resource in preparing for examinations, candidates should be aware that it is unlikely that a learning outcome will be tested using the same context in a subsequent paper. Rote learning of previous mark schemes will not be appropriate for answering all questions on a topic, particularly when being tested as AO2. Candidates are expected to apply knowledge in different contexts – something that they do not always recognise. In **F211** question **6(b)(i)**, for example, candidates were asked how vesicles move within cells and this question was not recognised as being related to the more familiar context of the interaction of organelles in the synthesis and secretion of proteins, which they would have studied.

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.

F211 Cells, Exchange and Transport

General Comments

The initial response from some candidates to this paper was that it appeared to be hard. However, well prepared candidates scored very high marks, and examiners were pleased with the way in which the paper differentiated across the ability range. At the lower end of the ability range, the performance of candidates sitting this paper was similar to that of past papers.

One aspect of this paper was that it tested certain familiar topics in a little more detail than in past papers. This applies to questions **1b**, **3bii** and **6**. These questions were designed to test familiar topics at a higher level of demand. The best candidates were able to demonstrate their understanding by applying their knowledge to the new contexts provided by these questions. However, it became apparent that those candidates who prepared themselves exclusively by looking at past questions, rote learning and learning the mark schemes were not able to adapt their answers to match the new contexts in these questions. Many weaker candidates struggled to apply their knowledge in a way that demonstrated a clear understanding of these topics.

A note about use of the additional pages for continuation of responses. Many candidates who continued responses on the additional pages did not mark their script to indicate that the response was continued. In most cases this is not a problem as a response that ends half way through a sentence suggests that there is more to come. However, if the response appears complete it is possible that a continuation on a later page may be missed or at the very least necessitates remarking that response. Candidates should be encouraged to mark an incomplete response with an asterisk or a short note to the effect that there is more to follow on the additional pages.

Comments on Individual Questions

1 This question was designed to be an accessible start to the exam. Part **(a)** in particular was intended to be a gentle introduction. Some candidates did find part **(b)** more testing than expected.

(a) **(i)** Many candidates were able to state that the air sacs were called alveoli and that they increased the surface area, gaining both marks. The most common mistake was to call the air sac a bronchiole or bronchus. There were a surprising number of candidates who were unable to give the response ‘large surface area’. The spelling of alveoli was variable and some responses such as ‘avioli’ and ‘aveoli’ did not gain credit. One enterprising candidate suggested the air sacs were called Alvin!

(ii) This should have been straightforward and many candidates did gain the mark for stating ‘squamous’. However, there were many variations of the spelling. The most common error was to call the epithelium ‘ciliated epithelium’ but ‘alveolar epithelium’ and even the imaginative ‘alvepithelium’ were seen.

(iii) Candidates were able to answer this question well with many being awarded both marks. They were often able to link recoil with the idea of pushing air out of the alveoli or with returning the alveoli to their original shape or size. The most common mistakes were to describe carbon dioxide being pushed out of the alveoli or to provide an unclear description of what structure was returned to size. Quite often weaker candidates had the airways being constricted or dilated by the elastic recoil. A few candidates made the mistake of linking recoil with inspiration.

(b) **(i)** This question asked a familiar topic in a little extra detail. This appears to have left many weaker candidates struggling to word their answers precisely. Many responses were insufficiently targeted towards explaining the effect of ventilation on the concentration of gases in the air sacs and vaguely described increasing 'amounts of oxygen', or there being 'more oxygen' or 'less carbon dioxide' in the air sacs. Some even wrote about concentrations of 'air'. Many candidates did gain credit for describing an increase in the concentration of oxygen in the air sacs. Very few candidates used the term partial pressure.

The more able candidates were able to write a concise response that simply said 'blood flowing in the capillaries carries away the oxygen'. Some candidates were able to bring in the idea of carbon dioxide being brought to the lungs or oxygen taken away, but did not always link this to the flow of blood. Weaker candidates generally repeated the answer to **(b)(i)** or tried to describe the presence of a short diffusion path. Candidates should understand that a short diffusion path will help to create a high diffusion gradient but does not maintain that gradient. A surprising number of candidates did not give a response to this question.

2 Part **(b)** of this question was designed to test candidates' ability to use their knowledge in an unfamiliar context.

(a) Many candidates did answer this question well but a lot did not gain full marks. The most commonly missed marks were 'differentiate' and 'cambium'. A surprising number of candidates seem to think that the unspecialised tissue in plants is xylem. The most amusing responses included the spelling 'merry stem' for meristem.

(b) **(i)** Candidates are used to seeing flagella on sperm cells or single-celled organisms that can move. Many better candidates realised that this cell was fixed in place and could not move. These candidates were able to work through what would happen as a result of the action of the flagellum and gained credit. Good candidates clearly understood that the flagellum produced a flow of water which brought food particles towards the collar of mucus. However, many simply stated that the flagellum aided movement of the cell or of the whole sponge.

(ii) Many candidates gained the mark for the collar of mucus trapping particles in the water which is a similar use to the way that mucus traps particles in the airways of mammals. There was a wide range of responses obtained and a lot of candidates tried to make a link with catching pathogens or bacteria so that the organism was not infected.

(c) Many candidates answered this question well and organised their answer clearly to indicate whether the comments referred to the xylem or the phloem. There are certain areas where candidates need to be more specific in their descriptions. Candidates need to be more precise about lignification, making sure they indicate it is the xylem <u>wall</u> that is lignified and thus the <u>wall</u> that is waterproofed. Few candidates described adaptations of the cell such as bordered pits in the xylem or the <u>many</u> mitochondria and the <u>many</u> plasmodesmata in the phloem sieve tube elements. A few candidates used the non-specific term 'nutrients' rather than the more accurate 'minerals' or 'sucrose'. Generally candidates' responses about the xylem were more accurate than those relating to the phloem but a few candidates were so confused that they referred to lignin as if it were a type of cell. It was disappointing to note that few candidates used the terms 'transpiration stream' and 'translocation'. Some candidates wasted time by discussing the general organisation of cells into tissues rather than focussing on xylem and phloem as examples.

3 This question asked about a familiar topic in a more detailed way than has been seen previously. It was designed to test how well candidates really understood this topic.

(a) Most candidates completed the first row (hydrostatic pressure) correctly. A few candidates used YES and NO rather than high and low. Many candidates were confused in their answers to row two. Examiners were hoping that candidates would realise that proteins in the tissue fluid would easily be carried into the lymph – so the answers would be the same. However, many candidates obviously gave this some thought as seen by the number of responses in which first attempts had been crossed out and a second or even third attempt made. Row three (neutrophils) also seemed to cause confusion and again many candidates crossed out first attempts to write alternative answers. In both rows two and three, many candidates compounded their difficulties by using words like 'some' or 'few' rather than a simple 'yes' or 'no'. Row four (erythrocytes) ought to have been more straightforward but many candidates seemed to think that there are erythrocytes in the tissue fluid.

Teaching Tip:
Candidates should be encouraged to follow the given word pattern when filling out a box and not inserting words or ticks that have not already been used in the box by the examiner.

(b) **(i)** "Maintain high blood pressure" and "faster delivery" were the most common answers. Candidates should be taught to write their answers on the separate lines provided as when numbered answer lines are provided, examiners look for an organised response in which the candidate has written one idea on each numbered line. Some candidates may have lost credit for writing two correct points on one answer line. Only a minority of candidates mentioned the ability to divert or direct the flow of blood although some gave vague descriptions of blood being moved "to where it wanted to go" or 'to where it is needed'. Blood is needed throughout the body and candidates at this level should be aware that such vague responses will not gain credit. Another aspect of some concern was that some candidates seemed to believe that keeping blood in vessels would increase of the rate of diffusion in gas exchange.

(ii) This was another question in which familiar material has been tested in a slightly more targeted fashion to determine how well candidates understand the topic matter. Most candidates knew something about the structure of artery walls but many failed to distinguish between those features needed to withstand pressure and those needed to maintain pressure. There were many answers which simply listed both sets of features in both sections. In the first section on 'withstanding pressure' many candidates knew that the wall was thick and this provided strength. However, few answers referred to the role of collagen and very few answers mentioned the folded endothelium. Many answers referred to epithelium rather than endothelium. Quite a few candidates suggested that cartilage or even lignin strengthened the arteries! The section on maintaining pressure was better answered as candidates gained credit for the role of elastic tissues recoiling and smooth muscle contracting to constrict the lumen. The concept of narrow or constricted lumen and blood being forced through a smaller space seemed relatively well understood. A significant number of candidates thought that arteries have valves to help maintain pressure.

Examiners were pleased to see that more able candidates demonstrated good knowledge and understanding as well as being able to use technical terminology correctly. Examples include references to:

- the corrugated endothelium allowing stretching without damage
- restricted blood flow allowing pressure maintenance in other areas.

The QWC mark was often awarded for using the terms elastic, smooth muscle and recoil. However, some candidates missed out on this extra mark because the words were used in the wrong section. Collagen was another word used frequently but it was, unfortunately, sometimes mis-spelled.

4 This question proved to be accessible for most candidates and many performed well. This is probably related to the fact that it had a relatively high proportion of AO1 (recall of knowledge) marks and so a candidate who had revised thoroughly could answer with confidence.

(a) Most candidates were able to define resolution accurately and scored at least one mark. However, clear definitions of magnification were not so common. Able candidates were able to define the magnification as the ratio of image size to object size but too many candidates gave vague responses that described the ability of the microscope to ‘zoom in’ or ‘make the image bigger’.

(b) This question was well answered with a significant number of candidates achieving both marks for this straightforward recall question. Marks were lost when candidates failed to include the units with their answer. Candidates should realise that a simple number with no unit is relatively meaningless. Some candidates were uncertain about the units and either left parts of the unit crossed out or wrote it so unclearly that is could not be deciphered. Candidates should be encouraged to strike through any mistakes and rewrite the answer clearly so that there is no room for misinterpretation. The other common error was to quote figures for magnification instead of resolution.

(c) **(i)** Many candidates identified the three dimensional nature of the image or the fact that only the surface of the nucleus was visible. Common errors included a focus on the level of magnification whilst comparing to a light microscope, showing they had not understood they were being asked specifically about the picture being obtained by a <u>scanning</u> electron microscope. Reference to a ‘black and white’ image was another frequent mistake. Some responses indicated an unnerving lack of understanding about how electron microscopes work with statements such as ‘the electrons are visible’ or ‘the electron beams blast parts off the specimen and make them more visible’.

(ii) Most candidates understood that they needed to divide 3mm by 25000 but a significant number got the final answer wrong. This was most usually because they were unable to convert mm to nm accurately. A few candidates failed to use the appropriate equation to calculate the size.

(iii) Most candidates knew that nuclear pores allow molecules into and out of the nucleus. However, some candidates used the terms 'substances' or 'things' instead of ‘molecules’. Other candidates lost a mark because they gave a correct example (mRNA) but failed to recognise that this does not enter and leave the nucleus – it leaves the nucleus. This question differentiated between those candidates who were a bit more thoughtful about their use of language and those who were not.

(d) This question was generally well answered and many candidates achieved both marks. Common errors were the inclusion of the nucleus, chromosomes and chromatin which possibly demonstrated a lack of practical experience in basic microscopy.

5 This question dealt with the familiar topic of transpiration. Candidates generally managed to answer this question well. Part **(b)(ii)** revealed that many candidates simply reel off their knowledge without really applying it to the specific question.

(a) **(i)** The majority of candidates recognised that there was an increase in rate of transpiration. However, many candidates did not quote figures from the table even though it was clear that two marks were available. Candidates at this level should be aware that a simple statement such as 'the transpiration rate increases' is not likely to be awarded two marks.

(ii) Only a small minority of students gained the mark for mentioning that the stomata were closed or would not have opened wider. Of those that realised that the light affected the stomatal opening, many failed to make it clear that it is the light intensity that is important and made vague statements that referred to the 'amount of light' or the 'level of light'. A number of irrelevant references were made to other environmental factors.

(b) **(i)** Many candidates were able to state that the stomata are open to enable gaseous exchange for photosynthesis. This simple statement gained three marks. Some candidates also referred to the inevitable loss of water vapour due to the stomata being open. Some candidates appreciated that other factors play a part, referring to the higher daytime temperature leading to greater evaporation. However, very few references were made to there being some loss of water vapour through the leaf surface at all times.

(ii) Candidates were asked to describe the features of the xerophytic leaf in the photograph and more able candidates were able to describe the thick waxy cuticle, the hairs and the curled leaf. These were accompanied by a brief explanation of how each featured helped to reduce loss of water vapour. Weaker candidates however, simply described the features of xerophytes and wasted time describing spines, sunken or sparse stomata and swollen stems. They also used vague terminology such as 'moist air' and 'the water potential gradient outside the leaf'. Many candidates referred to the 'evaporation of water vapour' which was not credited. Little clear distinction was made between the problems of evaporation of water from the leaf surface and water vapour leaving the stomata.

6 This question was designed to be higher demand and, as such, proved challenging to 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.

(a) Candidates were asked to state three roles of membranes inside cells. Good answers included a reference to the formation of organelles, the isolation of chemical reactions and the ability to regulate the movement of molecules into and out of an organelle. However, many candidates failed to read the question carefully and gave answers based on the roles of the cell surface membrane.

(b) **(i)** Many candidates achieved a mark for mentioning the cytoskeleton or microtubules. A second mark was occasionally awarded for mentioning the need for energy or ATP. However, only the best candidates were able to describe vesicles moving along microtubules through the action of protein motors or microtubules extending/breaking down. Some candidates appeared to believe that vesicles moved inside the microtubules much like a metro system or tube train.

(ii) Again, only the best candidates who understood the question and were able to apply their knowledge to this new context achieved marks here. The most frequently used correct response was reference to the complementary nature of the shapes of the receptor molecule and the protein molecule. Some references to the specific shape of the address protein were also made. The idea of address labels identifying the vesicle was often expressed in surprisingly unscientific language with descriptions such as 'the proteins decide where to go' or 'tell the organelles where to go'. Very few candidates suggested that the specific receptor might be found only on the correct target organelle. Many candidates confused their response with cell signalling and gave descriptions of hormones and receptors on cell surface membranes. Obviously there are many similarities with cell signalling, however, candidates were generally either confused or gave very vague responses suggesting that the proteins in the vesicle membrane were receptors or that the whole target organelle had a complementary shape to the protein.

(c) Many candidates gained 2 marks, although not all knew the process was called exocytosis. Many candidates did not answer the question directly and wasted time describing the synthesis of proteins in the ribosomes and the subsequent modification and repackaging in the Golgi apparatus before starting to gain marks. Weaker candidates did not refer to the cell surface membrane or used the term 'binds to' or 'attaches to' rather than 'fuses with'. A variety of other mechanisms for transporting materials across membranes were described including carrier proteins, channel proteins and facilitated diffusion. However, candidates should be aware that proteins are secreted by exocytosis, as it is fundamental to Learning Outcome 1.1.1(g).

F212 Molecules, Biodiversity, Food and Health

General Comments

The paper differentiated well in the middle to lower mark range but rarely did a candidate gain more than 80 marks.

In previous sessions it has been pleasing to report that candidates were increasingly understanding the command words *describe* and *explain*. However, this trend seems to have been reversed somewhat on this paper with many candidates explaining the graph on 7(b)(i) rather than describing it as instructed; this, coupled with many instances of failing to read the question carefully, cost candidates marks. The importance of reading the question more than once, and carefully, cannot be understated.

Examiner tip:
Underline or highlight the command word in a question.

For many candidates there was a definite pattern of high-performance on questions 1, 2, and 3 and poor performance questions on 4, 5, and 6. As has been noted in recent sessions, the importance of correct use and understanding of technical terms seems to be recognised by candidates in the biochemical units but not in the wider 'biodiversity' topics, where candidates think it is perfectly acceptable to use 'home' rather than 'habitat', 'average' rather than 'mean' and 'family', 'species', 'genus' or even 'phylum' interchangeably. Inappropriate use of the word *immune* was again a feature of this paper, but perhaps less so than in previous sessions.

It was surprising how many candidates who wrote outside the delineated areas, failed to give any indication that they had done so. Candidates will benefit from making clear indications that their answer may continue on the additional answer sheet and when writing in the additional space, making it clear to which question the answer refers. It is not a good idea for candidates to extend their answers anywhere other than the additional pages that are provided at the back of the question paper.

Comments on Individual Questions

1 This was intended as a comfortable question to start the exam, as it relied on basic recall of a topic which was probably taught near the beginning of the unit, with little application of knowledge.

(a) **(i)** A high percentage of candidates correctly gave N as the symbol, with some quoting C or O. Those few who wrote 'nitrogen' were not credited; nitrogen is not a chemical symbol.

(ii) The vast majority also got this right, with only a few incorrectly quoting 'dipeptide'.

(iii) This was also done well. Invariably, candidates drew diagrams (often very detailed) but this rarely added to their text. Nevertheless, the diagrams may well have aided the candidates to formulate accurate and detailed descriptions. Candidates are reminded that a diagram usually requires annotations to gain credit.

(b) **(i)** Candidates had clearly attempted to learn about the properties of water and many wrote in detail the about the nature of water molecules in terms of ionic interactions, polarity and strength of hydrogen bonds. Indeed, many candidates wrote so much about this that they ran out of space, and presumably time to discuss the biology. Only the candidates who were able to successfully link the general properties of water to specific aspects of the survival of organisms scored high marks. Vague statements like 'this helps organisms survive' were not credited. Many candidates were confused over the technical terms *latent heat of vaporisation* and *specific heat capacit*y, but later managed to pick up a mark by explaining what these terms meant. Given the larger number of resitting candidates it was surprising to see few references to enzymes or homeostasis as an advantage of thermal stability.

(ii) This was a question with a potentially wide range of correct responses. The secondary and tertiary structure of protein was often recognised and stated. However, many candidates simply named three proteins or stated larger groupings, like 'carbohydrates', which were too vague to credit.

2 This question took candidates from the reasonably precise to more open ended application of skills and many candidates who did well earlier on struggled on the last part of the question.

(a) Most candidates gained at least one mark by being able to identify the presence of a nucleus or membrane-bound organelles as eukaryotic features of *Plasmodium*. A surprising minority think that *Plasmodium* is multicellular and some confused eukaryote with prokaryote.

(b) Most candidates achieved this mark, most often for recognising that the species name should have a lower case letter. Some students thought the words should be reversed and a disappointing number refused to believe that there should be two parts to the name and that the correct answer should have been '*Plasmodium*'.

(c) **(i)** Most candidates achieved at least two of the three marks available. Too many students wasted time on the parasite's life history, which is beyond the requirements of the specification. Pleasingly, few candidates referred to *Plasmodium* as a virus or bacterium.

(ii) The vast majority of candidates were awarded this mark, usually with the idea of harming unintended species or humans. Weak responses referred to crop damage or stated that other species might be 'affected'.

(iii) Candidates struggled to impose structure upon their answers to this section. A significant minority of candidates misunderstood the reference to '*a population of Anopheles mosquitoes*' in the stem of the question and, having based their answers on the incidence of malaria in a *human* population, failed to score any marks. Lab-based answers produced higher scores, presumably because this is where students have most experience to fall back on in lessons and strong candidates could obtain full marks easily within the space provided. Field-based answers elicited a more rambling approach, suggesting that students find it difficult to select the important information that needs to be communicated when outlining a fieldwork strategy. Too many candidates referred to 'average' rather than 'mean' which was disappointing and mark-release-recapture was often described in far too much detail, suggesting that candidates had not recognised that 'state the steps' together with the limited number of marks available was trying to guide their response.

Teaching tip:
Students might benefit from more practice designing ecological surveys and experimental investigations which could generate meaningful data.

3 This question mixed the familiar with the less than familiar and many candidates struggled to gain high marks.

(a) The majority of students seemed to get the idea that cholesterol stabilises or regulates the fluidity of membranes. Many fewer got the second available mark. Those who did usually mentioned steroid hormones or bile production.

(b) **(i)** This mark eluded most candidates. Of those who did gain the mark, listing all the constituent elements was the most common answer. Many candidates mentioned branching with the majority of candidates making reference to the rings but this was often unqualified, and even when it was, the answers usually mentioned 6-carbon rings, which could not be credited because it suggested a fundamental misunderstanding of carbohydrate structure.

(ii) Most students successfully identified fats and proteins as the main constituents of LDLs.

(iii) This question was not well done on the whole. Some candidates tended to write in detail about the development of atheromas in general, the consequences of atheromas, the composition of lipoproteins or the idea of 'good' or 'bad' cholesterol. This left very little time or space in which to answer the question, which was about the contribution of LDLs and HDLs to the development of atheromas. Reading the question carefully will often save candidates time, if nothing else. This question was an ideal opportunity to gain all the marks very quickly, including the QWC, by use of a comparative table. As ever, there was a general lack of accuracy in describing where the deposition of fat occurs that leads to the formation of an atheroma.

(c) **(i)** It was quite common to see students connecting red meat with saturated fat. However, not so many could explain that red meat is associated with increased LDL levels. There was some obvious confusion about this as many answers stated that red meat *contains* lots of LDLs.

(ii) There were many correct answers here, most of which were CHD or coronary heart disease, although some marks were missed by candidates calling it 'chronic' heart disease.

4 Many candidates who were, until now, doing well on the paper began to struggle on this question.

(a) This was one of the most poorly answered part-questions. Clearly candidates are not comfortable using the key technical terms of classification. Only a handful of candidates scored all 3 marks. The best known term was 'phylogeny', but even here, the spellings were often too wayward to credit.

(b) **(i)** This relatively straightforward question on features of the animal kingdom was not done as well as had been expected. Many candidates gave features peculiar to birds! All marking points were seen but commonest correct responses were 'heterotrophic', 'multicellular', and 'eukaryotic' or a description of the latter. As usual candidates failed to recognise that an unqualified reference to movement is a risky characteristic to use, as many animals are not motile and many protoctists can move.

(ii) Around half the candidates achieved a mark with a reasonable spelling of Eukaryota. Animalia, Aves, birds, prokaryotes, and chordates were also seen.

(iii) Candidates often did very well or very badly on this part question. Stronger candidates correctly surmised that the kaka and kea were more closely related to each other than to the kakapo, and went on to give various of the marking points as the reasons. Few recognised the significance of their all being in the same family, indeed many wondered whether they might be in the same family despite having been told so in the question. Few also pointed out that the differences were great enough for the birds to be considered different species. Weaker candidates simply commented on the features that all the parrots shared, thus gaining no marks.

(c) **(i)** Most candidates had no difficulty with this definition, although a few copied the stem of the question and re-used the term 'variety'. A few candidates did not understand the command 'define' and discussed the *causes* of variation.

(ii) Most candidates got the marks for lengthy descriptions or examples when the single words 'genes' or 'environment' would have sufficed.

(iii) Reasons for a wide range of masses were themselves wide ranging! Barely a third of candidates correctly identified not weighing the entire population, and some also realised that if only a limited number of birds were sampled this might not be representative of the population as a whole. Common errors, some of which indicated that the question had not been read carefully, questioned the age of the birds, pregnancy, inaccurate weighing (incompetent personnel or poor scales) or weighing some decayed birds.

(d) A large minority of candidates gained full marks. Of those who did not, many were not able to answer the first part, and thus set themselves up to give a poor answer to the second part. Descriptions of isolation or the key terms natural selection and mutation were the most common correct responses.

5 Once candidates were away from the biochemical and health questions their lack of appropriate precision and clear use of terms continued to be a problem.

(a) Although this was a relatively straightforward calculation a significant number gained no marks and too many did not use common sense by giving decimal place answers when the question asked for a number of trees.

(b) Many candidates had learned rote answers but failed to notice that the question precluded them from mentioning 'biodiversity' and so they were limited to two marks.

(c) **(i)** It was rare to see an incorrect response, although references to plants in a botanic garden being 'in captivity' did not gain any credit.

(ii) If the candidate understood that the question was about why seeds should be conserved rather than their adult counterparts, they generally scored 2 or 3 but rarely 4. Many candidates wrote everything they had ever learned about seed banks. Marks usually came from the idea that many can be stored because they take up little space or from descriptions of long-term viability or protection from disease.

(iii) A little over half of candidates got the genetic diversity mark and many were able to describe the example of the advantage of genetic diversity in the context of disease resistance. However, it was rare for a candidate to achieve 3 marks. A number of candidates were not aware of the distinction between inbreeding and interbreeding.

6 It is disappointing that too many candidates are treating questions like this as a series of rote responses to be reproduced rather than demonstrating that they understand how theories are supported by evidence.

(a) This seemed to have taken many candidates by surprise and was poorly answered. The vast majority gained one mark for 'W'. A minority of candidates also gained the second point but only a handful got the third. Some candidates clearly did not see the terminal '(s)' in the column heading and used only one letter per box.

(b) Many candidates were awarded the first marking point, with rather fewer going on to recognise the impact upon humans or use a key term. Weaker candidates often confused the roles of vaccines and antibiotics, or antibiotics and antibodies. A significant minority did communicate the idea that new antibiotics would be expensive or time-consuming to develop. It was also pleasing to see less evidence of the usual confusion between 'immune and 'resistant' than has been evident in previous exam sessions.

(c) Many of the answers seen were not concise, making it more difficult to credit understanding. The most frequent mark awarded was for recognising that fossils show changes over time. Many responses focussed on the similarities, but if everything has remained similar, how does that support the idea of evolution? Few stated that fossils could be dated and even fewer gave an example of a well-known sequence or link species.

7 The whole question was a relatively straightforward opportunity to allow those who had learnt a topic well, and who could describe a graph, to gain some comfortable marks at the end of the paper.

(a) Marks for this question ranged between 2 and 5. None of the statements stood out as been especially 'unknown'.

(b) **(i)** Candidates who understood the command word *describe* often gained full marks. Some lost marks due to a lack of precision or incorrect reading from the graph. The difference in the gradient of the rise and fall was not seen very often. A worrying number of candidates *explained* rather than *described*, wasting a lot of time and often scoring only 1 mark.

(ii) The first marking point was nearly always awarded but the second much less frequently. Few showed the concentration at 60 days above the peak for the primary response. Some candidates did not show the rapidity of the secondary response clearly enough.

(c) Most candidates named the regions correctly; if marks were lost it was more often for function. The function for B was often just given as 'unchanging' or 'main structure of the antibody'. If the function for C didn't get a mark it was usually because the right idea was not taken far enough, ie the general idea of recognising rather than stating 'binding' or an acceptable equivalent.

F214 Communication, Homeostasis and Energy

General Comments

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

The extra time allocated for the paper certainly helped, in that candidates had enough time to finish the paper and fewer questions were not attempted at all. As noted in previous reports, many candidates still do not take the time to think about their responses before beginning writing with many scripts displaying lots of crossed out words or phrases.

As also 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. The initial view that examiners see is of that answer space and so guidance from the candidate will ensure that additional material is found. Candidates should also use any lined pages at the end of the paper for additional answers in preference to additional sheets or booklets.

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 **1(b)**. 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.

It was noticeable that some candidates exhibit confusion with areas of the specification within this unit, namely: respiration and photosynthesis; the liver and the kidney; sensory and motor neurones. These are areas in which candidates could benefit from clear and distinct guidance.

Teaching Tips:
Candidates should be encouraged to use a highlighter pen or pencil to identify key words in the stem or question and ensure that they read the questions carefully.

In the questions with a mark allocated for Quality of Written Communication QWC (with the pencil icon) they should be encouraged to write down all the technical words that link with that question in the margin before they begin their response and certainly use at least three technical terms in their answer.

Teachers should also advise their students that if they are not sure of the correct spelling then they should not use the term itself and just write a description, otherwise they risk losing marks if the spelling is ambiguous or contradictory (as in the case of question **1(a)(ii)**).

Comments on Individual Questions

1 This question was designed to be an accessible start to the exam. Part **(a)** was on a familiar topic, asked in a straightforward way that would be familiar to candidates.

(a) (i) Candidates who had a sound understanding of the term answered with a text book definition. Good answers were precise but some candidates gave extended and vague accounts of negative feedback or single specific examples.

(ii) There were many good accounts seen in response to this question, displaying good understanding. There was some confusion with the terms used such as glycogenesis, glycogenolysis and gluconeogenesis and when these contradicted other statements made or had ambiguous spelling then the marks were not credited. Some candidates appear to have incorrect ideas relating to the detection of blood glucose concentration while a small proportion made mistakes in either describing the conditions under which the hormones are released or their effects on body cells.

(b) This part of the question was targeted at the more able candidates, incorporating some stretch and challenge. Many misread the question and answered in terms of the characteristic features of the two types of diabetes rather than applying the information given to the question asked.

(i) This was the easier part of the question and candidates generally coped well with it. Some were unable to distinguish between 'diet having no effect' and 'a change in diet' having no effect.

(ii) In order to answer this question, candidates were expected to concentrate on the late onset aspect of the man's condition – references to diet were inappropriate and answers including these were not credited.

2 (a) (i) Many candidates were able to correctly state the liver, although a significant proportion incorrectly suggested the kidney despite the fact that 'produces' was emboldened in the question.

(ii) Many candidates had some understanding of the link between protein and urea production. It was noticeable, however, that there are some misconceptions or errors in description. A clear, logical account that covered the individual steps scored well but few associated the increased intake of protein with more amino acids, some thought that proteins couldn't be stored in the body and that they were deaminated. Very few associated a high production of urea with an increase in blood urea concentration and thence an increase in the concentration in urine.

(b) Candidates were generally able to supply a suitable condition, commonly diabetes or a suitable kidney condition. Hypertension or hyperglycaemia were not credited as, in themselves, it was not considered that they would commonly cause glucose in the urine.

(c) (i) Many candidates could identify the correct hormone, although some who gave both the initials and the name stated the name incorrectly and so were not credited. Some wrote the initials in the wrong order while others suggested any female hormone. It is worth noting that the command word used in the question (state) indicated that candidates could identify the hormone by initials rather than in full. Had candidates been asked to 'name', then the full name would have been expected and initials would have been insufficient.

(ii) Some good, clear accounts were seen but many accounts did not distinguish between the different antibodies and consequently were imprecise and muddled. The candidates were expected to use the information on the opposite page and could have used the terminology to assist their descriptions. Some otherwise good answers failed to indicate *binding* of the antibodies. The role of the control testing was not always understood with many not referring to it or, when they did, they usually just said that a colour line was a positive test. Many thought it was to 'compare' with the LH line.

3 This question related the structure of the chloroplast to photosynthesis. Parts **(a)(i)** and **(b)** required careful thought and application.

(a) **(i)** Strong candidates answered this well, with many candidates gaining at least three of the available marks. Weaker responses indicated that the candidates thought that they were looking at a whole cell. Common mistakes included: 'W' as a plasma/cell membrane; grana and thylakoids muddled; stroma identified as matrix or cytoplasm.

(ii) Most candidates could gain one mark for identifying the role of ribosomes and/or DNA. However, given the phrasing of the question, candidates were expected to relate the protein coded for or synthesised to the role of the chloroplast by, for example, referring to a named enzyme or the involvement of an enzyme in a specified photosynthetic pathway. Full marks could only be awarded if both aspects of the question had been addressed. A significant number of candidates answered in terms of a cell (or mitochondrion) rather than chloroplast.

(b) It was pleasing to note that candidates did not have a problem following the rubric and used the letters as instructed. Most candidates gained three or four of the available marks, the most common incorrect answer being the first row.

4 This question proved to be the most challenging for candidates as it involved analysis of practical procedure and appreciation of synoptic material to answer competently.

(a) **(i)** Most candidates answered this correctly. Some candidates, however, only supplied one of the required answers.

(ii) This was answered correctly by most candidates. The common error was to supply other/all stages involved in aerobic respiration.

(b) **(i)** Few candidates appreciated the need for the glass beads in respirometer B. Inappropriate suggestions included: absorbing moisture; spacing the seeds out; providing oxygen; absorbing carbon dioxide; regulating temperature. Some appreciated that the soaked peas would occupy more space than dried peas, but most comments of this type were associated with reference to mass rather than volume. Some provided comparisons with respirometer C, not having read the question thoroughly.

(ii) Those candidates who had answered **(i)** in terms of mass, were often able to gain some marks here, as an error carried forward. The need to determine the difference in volume between the 30 soaked and 30 dried pea seeds was often not stated explicitly. There were very few references to the volume of a single bead in determining the number required.

(c) **(i)** Many candidates achieved full marks for the correct answer of 0.014. The most common error was to leave the answer unrounded as 0.0135, which is not consistent with the rest of the data in the relevant part of the table.

Teaching Tip:
All data in a particular column should be given to the same number of decimal places – it can be emphasised by explaining it in the context of making the table look consistent.

Candidates need experience in ensuring that data is presented in this way, both in the practical assessments and theory papers, as this is a feature that spans the whole specification. Tables with in-built errors can be given to candidates and they could be asked to identify the errors.

(ii) While many candidates referred to enzymes 'working better' at 25^{o}C, only the better answers drew on AS material to refer to increased kinetic energy and then to link the increased respiration rate to enzyme involvement. If enzymes were named, examiners were looking for those that would be free to move rather than those embedded in membranes (which would be less affected by increased kinetic energy). Examiners were looking for a direct link rather than for enzymes and respiration to be simply mentioned in the answer but unconnected. A significant number referred to photosynthesis rather than respiration.

(iii) Few candidates appreciated that most metabolic reactions require enzymes and substrates to be able to move and therefore require a liquid medium. Those who pursued the idea of the respiring seeds requiring more ATP for increased metabolism often failed to make clear statements, frequently restating information given in the question (such as 'the soaked seeds are germinating') which did not gain credit. Many concentrated on photosynthesis rather than respiration and suggested that the water would be used for photolysis and hence ATP production.

5 **(a)** Most candidates could correctly identify **F** as the renal or Bowman's capsule. Answers to **E** were more varied, with many incorrectly suggesting 'nephron' (which was considered to be too vague) and 'loop of Henle'.

(b) **(i)** Many candidates concentrated their efforts on the question that had been set however a significant number did not confine themselves to the glomerulus but included all aspects of the glomerulus and renal capsule. Marks awarded were generally high, although they could be obtained by concentrating on slightly different aspects of glomerular function. Common misconceptions included the arterioles being identified as capillaries or arteries and the idea that blood entered the glomerulus at high pressure rather than the pressure building up or being maintained within the glomerulus.

(ii) Most candidates answered this correctly, although some were less specific and suggested epithelial cells, which was not precise enough.

(c) **(i)** Candidates often seemed to have some idea of what might happen as a result of kidney failure however they generally dealt with this in terms of urine content rather than blood composition. Given the phrasing of the question, examiners only credited statements relating directly to blood composition. Some gave conflicting information, eg increase in urea content and little glucose, and this was only credited if stated in a correct descriptive context. Even when the blood composition was described, a common error was to state that urea was present rather than indicating increased levels.

(ii) Candidates answered this with a degree of confidence, gaining at least one or two marks. Marks were lost due to a lack of precision in the description and the most common error was to describe the rejection by the immune system as autoimmune. The use of immunosuppressant drugs was recognised, although some suggested that a kidney that was not closely matched would be more likely to produce infection.

6 **(a)** Most candidates gained marks for gaps 4 and 5 for 'potential' and 'impulse'. Some candidates spotted the word sensory next to the first gap and answered 'neurones' without realising that the statement was in the context of receptors. Common errors for the second gap were 'frequency' or 'colour', which are too closely related to wavelength already given in the passage. Gap 3 was answered correctly least often with common errors including olfactory, taste and smell. For gap 4 it is worth noting that while we accepted 'level' in this session, 'potential' or 'value' should be the terms used by candidates.

(b) **(i)** Many candidates answered this well, with common correct answers referring to the longer axon of motor neurones, or the cell body of motor neurones being located in the central nervous system. Candidates who referred to sensory neurones were still able to gain the mark with a correct description. Common errors included describing the cell body of a motor neurone as being located 'at the end' without making it clear that it is located at the end of the neurone. Note that a cell body at the end of 'the axon' was not creditworthy. Some candidates are still under the misconception that motor neurones are myelinated and sensory neurones are not, or vice versa. A small but significant proportion of candidates appear to describe the neurones the wrong way round. The guidance given to examiners in the mark scheme means that if more than one answer is given and the additional answer is incorrect then a mark is not awarded. Some candidates contradicted a correct answer by supplying an incorrect one.

(ii) Many candidates also answered this part of the question well. Common correct answers included the motor neurone carrying the impulse from the central nervous system, or carrying the impulse to an effector. Some candidates were not credited as they failed to specify what was being carried: for example 'the motor neurone connects the central nervous system to the effector'. The most common error in this question was to talk about the transmission of signals, messages, information or stimuli and it is worth reminding candidates of the importance of using the terms 'impulse' or 'action potential'.

F215 Control, Genomes & Environment

General Comments

Some candidates showed an excellent standard of recall and understanding, both of the F215 learning outcomes and of the material assessed synoptically. Many candidates performed well across all the questions in the paper, showing no particular areas of weakness. The most challenging questions proved to be **2 (e)**, where good answers developed knowledge from F211, F214 and F215 in combination, and question **6**, which was searching in terms of testing candidates' integrated understanding of genetics, selection, evolution and classification.

Handwriting was barely legible in some cases. In addition, frequent crossings-out and poorly thought-through answers spilled beyond the answer space or onto the additional pages. It is absolutely imperative that candidates clearly signal when and where they have continued extended answers, ideally with a page number. Answers should not be written beyond the four corner markers on each page.

Candidates should be encouraged to plan their response before beginning to write. The best guide to answer length is the mark allocation for each question, not the number of lines, as the space provided caters for those with the largest handwriting. Use can be made of the mark schemes from previous sessions to train candidates to write concise answers concentrating on listing the relevant facts. With 120 minutes available to gain the 100 marks on offer, candidates should have ample time for reading the questions and planning their responses. Good candidates will use this time to provide more carefully tailored, precise answers which make full use of the technical vocabulary they have learnt. Weaker candidates this session used the time to extend their answers in a scatter-gun approach at the back of the answer booklet, rarely picking up extra marks for these additional afterthoughts or for poorly-expressed ideas that lacked clarity of purpose or relevance to the original question asked.

QWC on this paper involves following instructions with regards to sequencing ideas logically or achieving a fair balance, coverage or comparison of different aspects of a topic in a longer answer. Candidates need to ensure they read the italicised instructions carefully and structure their answers accordingly.

Comments on Individual Questions

1 This question provided candidates with the opportunity to earn accessible marks early on through interpreting the flow diagram, recalling and explaining genetic terms, and using their own knowledge to extrapolate from the information given. Parts **(b)**, **(c)** and **(f)** proved the more challenging question parts.

(a) Virtually all candidates gained the mark for identifying tyrosinase as the enzyme that catalysed the last step in melanin production in **(i)**, but fewer named phenylketonuria as the relevant genetic disorder in **(ii).** The commonest error in **(ii)** was 'albinism'**.** A small minority of candidates did not make use of Fig 1.1 at all and answered with the names of other enzymes and disorders that they were familiar with.

(b) As is always the case in A2 papers involving synoptic assessment, recall of biochemical knowledge from AS is a weakness for a great many candidates. While a proportion of candidates had secure knowledge of the characteristic chemical groups of an amino acid, the weakest answers confused amino acids with nucleotides. Additional knowledge such as the fact that three DNA or RNA nucleotides code for each amino acid in a polypeptide was not relevant here. Candidates who scored 2 marks here often included a structural formula diagram of a generalised amino acid.

Candidates who scored 1 mark only often referred to an 'acid' group without specifying 'carboxylic'. There was some confusion between amine (correct) and amide (incorrect) groups.

(c) A surprisingly high number of candidates did not use straightforward logic to process and synthesise the information given in the question stem and Fig 1.1. Instead they jumped to the opposite conclusion that people with the condition congenital hypothyroidism would have more active mitochondria rather than less active. Candidates frequently picked up on the term 'metabolism' in the question and better answers stated that the metabolic rate would be slower (as opposed to the more ambiguous 'metabolism would be lower'). Many candidates scored for saying less ATP would be produced but some fell foul of Newton's law of the conservation of energy by stating that less energy would be made or produced, which is not acceptable. The preferred term is to say that less energy is **released** in respiration. Some candidates accessed the AVP idea of the sufferer experiencing fatigue or lethargy but few commented on muscle tone or body temperature being adversely affected. A reasonable proportion gained three marks but many who reasoned incorrectly scored no marks.

(d) Well-prepared candidates found this section an easy mark-winner. Most gave homozygous as the appropriate term in **(i)**, though wrong answers included homologous and heterozygous. Candidates who had learnt clear, concise definitions of the terms in **(ii)** (genotype and allele) such as those given in the mark scheme, scored full marks. Those candidates who struggled to put nebulous ideas into their own words for the first time frequently dropped a mark or two. In explaining the word genotype candidates need to refer to the context of a person or individual. A common error was to refer to genes rather than alleles in explaining the word genotype. In explaining the meaning of the term allele candidates need to stress that it is a different or mutant or alternative version, not just 'a version' of a gene.

(e) Nearly all candidates made sense of the information given and correctly stated that the zoo population would be too small and would not show random mating.

(f) The commonest correct answer was selection, followed by mutation. Very few candidates cited migration. Answers that listed genetic drift scored a mark, but those that padded out the term with a contradictory description did not. Many candidates wrongly think that genetic drift is just another term for natural selection. Candidates should be encouraged to use their technical vocabulary and to choose the most apposite biological term whenever possible in their answers. On this question some candidates, despite the instruction to 'list', described the operation of a selection pressure in a scenario without ever using the terms selection or selective, and consequently scored no mark.

> **Teaching Tip:**
> The F212 understanding of natural selection needs to be revised and built on when teaching both artificial selection and genetic drift. In both cases it would be instructive to list differences and similarities between these pairs of processes.

2 This question assessed synoptic knowledge and understanding of the fight or flight response.

(a) This provided an easy introduction with most candidates correctly following the instructions and listing external features that could be observed in the photograph of the second husky as being different to the calm husky. A few described an internal change that was not clearly visible, for example 'muscles tensed'.

Some candidates were unable to use terms precisely enough to convey what they observed, saying for example, 'eyes dilated' rather than 'pupils dilated'.

> **Teaching tip:**
> Even in a simple exercise like this candidates need to be aware of how they are using language to convey their ideas and understanding. A modified Pictionary game could be played where one player gives an oral description of a biological structure without mentioning its name or a number of other key words, and the other player tries to draw it based on the description.

(b) Again, most candidates were able to pick up on the salient instructions in order to select **internal** structures that qualified as **organs** and that were not alluded to directly in the question stem, such as structures involved in secreting adrenaline or parts of the autonomic nervous system. The commonest correct choices were heart and lungs, though candidates also scored with liver, gut or a part of the gut, and arteries to muscle. External organs such as skin and eye were not accepted and nor were sub-structures within organs such as bronchioles, though error carried forward marks were available in some cases. A third category of error was to select an internal organ such as the brain or bladder (which each scored a mark) but where there is no simple, consistent difference between the functioning in a calm and a frightened mammal because the response depends on the degree of stimulation or the learnt behaviour of the organism.

> **Teaching tip:**
> Just as using language is crucial to enable a candidate to express ideas or observations, so is understanding the language used in the question. A useful exercise is for candidates to highlight a set, limited number of key words in each question on a paper, so that they get used to picking out the most important words that delimit the acceptable range of responses.

(c) This provided candidates with an opportunity to show simple recall of information. Many recalled the salient names correctly. Some mismatched the names parasympathetic and sympathetic to the states of calmness and fright, but if the neurotransmitters they named in each case matched their choices they gained error carried forward marks. A common mistake was to state 'adrenaline', the hormone, instead of 'noradrenaline', the neurotransmitter. Brain neurotransmitters that are not secreted at peripheral organs (eg dopamine and serotonin) sometimes cropped up, but the commonest error in the second line of the table was to get the two correct neurotransmitters mixed up.

(d) The two marks available for stating precisely where adrenaline is produced were for firstly, the adrenal gland(s) and secondly, for specifying the medulla region of these glands. Candidates without any further knowledge of the substructure of the adrenal glands wrote 'near kidneys' in an attempt to locate the hormone production site more precisely, though some located the adrenal glands wrongly in the liver or brain. Some candidates lost one mark for choosing cortex instead of medulla and some gained none for writing medulla alone, or medulla oblongata or medulla in brain. A great many candidates seemed unsure of the location and hedged their bets by giving two different answers, usually the adrenal glands and the pituitary gland or hypothalamus. Giving an incorrect answer in addition to a correct one, whether the error is written before or after the correct response, results in no marks being awarded (see 'first answer' rule on mark scheme). Candidates should write lists of

additional answers with caution therefore. The 2 mark allocation may have suggested to intelligent candidates that there were two correct answers but here that was not the case, so candidates need to be warned that 2 marks may be given for a **precise** two-word location, as here.

(e) It was possible for candidates to score full marks in **(i)** by combining knowledge of F211 cell signalling (hormone binding to cell surface receptor due to complementary shape matching) with the F215 learning outcome that cAMP activates proteins by changing their three dimensional shape. However most high-scoring answers also drew on knowledge recalled from the F214 unit regarding the conversion of a hormone signal to a rise in the concentration of the second messenger molecule cAMP. Candidates who did not recall F214 knowledge or did so only patchily most often scored marks for the hormone-receptor binding idea and sometimes the complementary shape matching. It was a shame that those who mentioned cAMP very often did not link it to adenyl cyclase or know that it was formed from a starting point of ATP. There were many erroneous ideas expressed about the supposed ability of adrenaline to pass through the cell membrane into the cytoplasm or to trigger ion movements through the cell membrane, with many candidates going off on tangents to do with events at a synapse or neuromuscular junction.

Part **(ii)** was designed to challenge the most able. Few candidates realised that a single adrenaline molecule triggers the production of multiple second messenger molecules and that this amplification continues at each of the steps in the signalling pathway. Some candidates seemed to have an inkling of this cascade effect but struggled to put their idea into words, using terms like 'domino effect' and 'chain reaction'.

Teaching tip: Candidates need to have a secure grasp of all areas of the AS specification, AS and A2 practical skills and of F214 (as a number of the F215 Learning Outcomes build on work already covered in F214) before attempting F215. A number of topics on F215 follow on from previous work and as stated in the teaching tip for **1 (f)**, it is always a good idea to revise or reference relevant earlier material before teaching the new material in order to embed the new details into the appropriate context.

The mark scheme for **2e (i)** can be used as a starting point for students to draw a flow diagram of the complete sequence of events that occurs when adrenaline binds to its target cells. The stage most often omitted from answers was the G protein shape change.

3 This question first tested knowledge of ecological terms and the ability of candidates to draw upon a broad base of case history studies and fieldwork to provide specific examples of the key ecological interactions studied. Students were then asked to apply their knowledge of plant hormones to two ecological scenarios and finally to describe the methodology of transect-based field work. Candidates scored well on the question overall but the practical skills description was the weakest part.

(a) Almost all candidates answered this section successfully demonstrating their understanding of the terminology associated with this section of the specification. A small number of candidates lost the mark for section **(iii)** by confusing the terms habitat or community for the correct answer, ecosystem.

(b) Most candidates scored freely on this question. The most frequent interactions referred to were the two on the specification, interspecific competition and predation. A smaller number of candidates gained credit for describing an example of mutualism. The candidates who were not successful in answering this question were those who failed to meet the requirement to describe **ecological interactions between two different species**, instead describing intraspecific competition (one species), succession (indirect interaction mediated by the environment) or forms of behaviour (not ecological interactions in the sense of the question). Some candidates also lost marks by failing to name species, instead using terms applicable to much larger taxa such as 'birds', 'grass' or 'trees'. While competition most often cited the pairing of red and grey squirrels, there were some good examples taken from case studies on the Galapagos, such as competition for grazing between goats and giant tortoise. Predation was most often illustrated by fox and rabbit, but lynx and snowshoe hare also appeared. Candidates tend to be very conservative in their choice of examples, relying on sparse textbook examples and ignoring the wealth of interactions they must see around them in the real world and on natural history programmes on the television.

(c) Although most candidates scored some marks on **(i)**, few gained maximum marks. Most successful responses stated that plants would grow taller and named auxin as playing a role in bringing about the plant's response. Fewer answers referred to phototropism or the growth of roots to gain additional water or minerals. A minority of responses referred to thigmotropism or allelopathy. Lack of precision lost some candidates marks as in the description of 'plants growing towards light' (which could mean upwards) rather than bending towards light. Surprisingly few used the term phototropism.

Most candidates scored at least 2 marks for **(ii)**, with the majority recognising that auxin levels would fall and that this would result in the growth of side shoots. Fewer referred to the removal of apical dominance. It was clear that many candidates understood this term but they did not refer to it as no longer operating once the shoot tip had been removed.

(d) Most candidates scored marks here although relatively few gained maximum marks on what is a fairly straightforward question. Most successful responses referred to the use of interrupted belt transects to measure the percentage cover of the plant species present. Fewer referred to the initial marking out of the transect by using a tape measure or rope or to using the ACFOR scale to estimate of abundance. A number of responses correctly described the use of a point frame although the use of keys to aid identification or pre-prepared data recording sheets was rarely mentioned. Some candidates appeared to have misread the question and described the procedure for measuring the abundance of plant species in an area of 100 m^2, rather than over a linear distance of 100m. Random placement of quadrats was not relevant to carrying out this fieldwork, and nor should the site for the transect have been chosen randomly. Many responses appeared to be poorly planned with contradictions in the chosen method, time lost repeating information previously given, and inclusion of details such as data processing that went beyond the requirements of the question. Candidates should be made aware of the importance of spending a few moments in planning a long answer such as this before starting to write down their ideas.

Teaching tip:
In the absence of time for endless fieldwork a few standard principles should be taught and candidates asked to make flow diagrams of how these techniques can be variously incorporated into different procedures to achieve different goals or to prove different hypotheses. Many answers from candidates lacked the sense of a goal or purpose. The question had a clearly focused goal corresponding to learning outcome 5.3.1j matched with a practical task outlined at the end of specification section 5.3.2.

4 This question was accessible to most candidates and many performed very well. It had a high proportion of AO1 (recall of knowledge) marks so a candidate who had revised thoroughly could answer both sections with confidence.

(a) The answers here showed that candidates have learned genetic modification methods well. Writing was clear with few crossing-out and over-writing and students obeyed the rubric and gave just one answer per line. The majority correctly identified the enzymes that cut and join DNA. The vector that was least well known was the one used to introduce foreign DNA into plant cells, *Agrobacterium tumefaciens* or its plasmid, despite this detail being mentioned in some texts in the context of introducing genes into 'Golden Rice ^{TM}'. A range of answers was possible for each situation that required a suitable vector to be named.

(b) Well-prepared candidates who knew the range of arguments and could express them clearly gained full marks. To access the QWC mark a benefit and a concern needed to be stated for both the modified organisms, so candidates with 3 marks or fewer were unable to access the QWC mark awarded for a balanced account. It was important that candidates realised that the intended context of use of 'Golden Rice^{TM}' is LEDCs or areas where rice is the staple diet. Some thought its intended beneficiaries were vegetarians living in the West. Deficiency symptoms described quite frequently matched Vitamin D rather than Vitamin A and candidates do need to argue that deficiency symptoms will be reduced by the intervention, not just list symptoms and leave this logical deduction to the examiner. Threats to the genetic diversity of rice were not well known and nor was the concept of possible gene spread to wild varieties of rice. Despite a parallel situation being examined on the June 2011 paper, few stated that a clone would suffer equally from a particular disease or environmental change. Good answers sometimes raised the questions of financial exploitation of farmers and the adequacy of levels of vitamin A contained in the rice.

When discussing the ethical concerns about somatic gene therapy, many answers confused somatic with germ line gene therapy and argued irrelevantly about designer babies and embryo research. Most answers stated that symptoms of disease would be reduced, though a few merely copied information in the question and said the technology would 'treat disease'. A surprising number of candidates muddled the terms 'quality of life' and 'standard of living'. Some gave examples of single gene recessive conditions which would benefit, usually cystic fibrosis. The most successful answers discussed the temporary but invasive nature of the treatment. Few candidates raised animal testing concerns, rejection by the immune system or health problems caused by the vector.

As the mark scheme shows, there is a long list of real ethical concerns that can be studied and learnt about, but the trite phrase 'playing God' is not one of them and did not score. Candidates' understanding of the interplay of the major world religions with these examples of technological progress was almost universally naive. The movement of DNA from daffodils to rice does not pose a problem under the dietary laws of orthodox Jews. The prospect of improving health and nutrition for millions of poor people is likely to be welcomed by organisations such as Christian Aid. The establishment of the major religious texts long before the discovery of DNA means that there is no a priori reason why supplementation of working DNA to body cells should be more frowned upon than any other medical procedure. The collective understanding of A level students seems to be that scientific advances and religion are implacably opposed, which seems to do a disservice to the altruistic nature of the work of both the scientific and religious communities.

5 Five technical terms connected with biotechnology were requested within the context of a simple crossword with descriptive clues.

Many candidates were able to complete the crossword correctly.

The majority of candidates recognised the culture method described was **continuous.** The spelling of **immobilisation** and **biotechnology** caused candidates some problems, although these terms were usually correctly supplied for 1 down and 2 down respectively. **Aseptic** and **asepsis** were both acceptable alternatives for the sterile technique, which presented few problems for candidates.

4 down was the least likely to be attempted, with a significant number of candidates unable to name **fungi** as the eukaryotic kingdom with cell walls made of chitin. This draws synoptically on F212 knowledge of taxonomy, though candidates may also have remembered budding in yeast from F211 and recalled the structure of the fungal cell wall from this.

6 This question was the most challenging on the paper, probing applied understanding (A02) of a variety of aspects of genetics, selection, speciation and taxonomy from specification section 5.1.2.

(a) Most candidates correctly named artificial selection or selective breeding in part **(i)**. Many wrong ideas surfaced in part **(ii)** however, Some thought that as males are more aggressive than females there were fewer males to choose from, showing a lack of understanding of the concept of percentage. The commonest correct point made was that fewer males are needed as each male can mate with several females, but very few candidates realised that a stronger selection pressure could therefore be exerted by choosing fewer males. Confusion was shown when terms like mating, breeding, reproducing and fertilising were muddled, sperm were confused with 'semens' and ova with ovules. While reproduction is not on the specification, meiosis and the concepts of random mating and fertilisation are. Some candidates assumed that breeding would be through artificial insemination rather than through arranged matings. Candidates struggled to express the reasons why more females were needed, either in terms of the limit to the reproductive output of females or in terms of maintaining a reasonable population and gene pool over the forty generations of the experiment.

Teaching tip:
The arguments in the mark scheme should be carefully considered to see the subtle differences between the ideas when using this question in teaching.

(b) Good candidates were expected to conclude that the increase in frequency of the trait after 35 generations of consistent selection clearly points to a genetic basis of tameness. Despite the evidence presented, some incorrectly surmised instead that training and the environment (human contact) was the main factor. Good candidates may have queried the extent to which the environment was controlled in the experiment, or mentioned that the phenotype of tameness may also have an environmental component, but were clear that a genetic basis is indicated by the results. The best candidates linked selection to the increase in frequency, rather than just describing the increase as occurring 'over the generations' or 'over time' or quoting the figures alone. They also made use of the word allele. A few candidates showed excellent synoptic integration in suggesting that a tameness allele might affect a brain neurotransmitter receptor like DRD4, showing that the genetic link with behaviour exemplified in the DRD4 studies has not gone unnoticed.

(c) The number of marks gained in this section very much depended on which genetic hypothesis the candidate chose to enlarge upon. All were viable options for gaining two marks, although in fact none of these explanations is the correct one (see research paper listed in Teaching tips for a full explanation.)

Candidates who chose linkage were most likely to gain two marks, as this term has presumably been clearly explained as prescribed by the specification (5.1.2c), although wrong answers that the two genes share the same locus rather than chromosome cropped up.

Epistasis usually allowed candidates to gain one mark, although there was confusion between masking the presence of a gene and masking or affecting its expression, and few candidates gave details of how epistasis operates via gene products interacting in enzyme pathways, although this area has been examined in previous F215 papers.

Candidates who chose genetic drift often showed, as in **1 (f)**, that they thought genetic drift was a new word for selection or survival of the fittest. The concept of chance needs to be stressed in teaching genetic drift.

Lastly, a large number of candidates chose inbreeding though they were least likely to have been taught this explicitly. As a consequence their answers were imprecise and they generally did not realise that traits that were not originally present or knowingly selected for in the founder population but that appeared with increasing frequency after generations of inbreeding are controlled by recessive alleles. These increasingly arise in homozygous combinations in later generations due to the relatedness of the parents.

Teaching tip:
If candidates are given a choice, rather than going for what seems the most likely but unfamiliar explanation, they should choose a reasonable explanation that they have studied and can discuss with authority. Candidates should be looking for opportunities to show what they know.

(d) Many candidates listed a number of relevant isolating mechanisms, the most well-known being geographical, seasonal, behavioural and mechanical. Unfortunately most who gained a mark for 'geographical' did not consider the wolf-dog scenario and give a reasonable supposition about early domestic dogs being kept away from wild wolves by humans, but instead posited earthquakes, mountains, rivers and volcanoes as separating the two populations. The words 'seasonal' and 'temporal'

were not always understood as referring to differences in breeding season. Mechanical was well-explained though some candidates described differences in 'geneticals' and even 'plumbing' rather than in genitalia. The inability of small dog mothers to carry pups of big breeds to term was also credited under mechanical isolation.

(e) This proved very challenging although most candidates scored one mark for a correct definition of the biological species concept of interbreeding to produce fertile offspring. The definitions given for the phylogenetic species concept (identified as cladistic/evolutionary in the specification) were poor and rarely focussed on the DNA similarities and differences and the shared ancestry and common descent with degrees of divergence that are at the heart of the concept. The markscheme should prove useful for teaching this, and words like clade and monophyletic should be taught and understood.

Aside from quoting definitions, many candidates were afraid to apply the separate definitions to the situation described, and to draw appropriate inferences that conflicted with the received wisdom that wolves and dogs are different species and that all dogs belong to the same species. Exceptional candidates had the confidence to discuss different angles and interpretations like this and gained the four marks.

Teaching tips:
Video footage of the silver fox experiment can be found in the BBC Horizon programme, 'The Secret Life of the Dog'. Also of interest may be 'Woof! A Horizon Guide to Dogs' (BBC4, March 2012). Some of the latest research findings about DNA similarities between different dog breeds are covered in National Geographic magazine, February 2012.The original breeding experiment referred to in the question is summarised in a research paper by Lyudmila N. Trut (1999) in American Scientist, available to view at the University of Utah website via this weblink: http://www.hum.utah.edu/~bbenham/2510%20Spring%2009/Behavior%20Genetics/Farm-Fox%20Experiment.pdf.

7 This question tested those aspects of homeobox genes that are highlighted in the specification, that is, their role in development and the similarities between these control sequences in different kingdoms of eukaryotes. In general, candidates' knowledge of the importance of homeotic genes was sketchy and suggestions are made below for improving the teaching of this topic.

(a) Most candidates scored one mark for stating that homeobox genes control development or body plan. Few candidates seem to be aware that the products of these genes act as regulatory proteins, switching on and off suites of other genes. The details of the common sequence shared by the animal homeobox genes (the 180 base pair homeobox sequence) and how this codes for the DNA-binding part of the protein were similarly known by only a few candidates.

Teaching tip:
The link between the *lac* operon, detailing gene regulation in prokaryotes, and homeotic genes, an instance of gene regulation in eukaryotes, should be firmly stressed. The action of homeotic genes in development can also be linked back to the F211 material on stem cells and control of differentiation. The idea of a cascade of reactions happening in the hormone-cAMP signalling transduction system becomes more relevant to this section of the specification when it is compared with the cascade of sequential events that occur when maternal effect genes influence layers of segmentation genes which then switch on and off the relevant homeotic genes, although it should be noted that maternal effect, gap and pair-rule genes are **not** themselves homeotic genes.

(b) Many candidates realised that alteration in a homeotic gene meant a reduced chance of survival, but they did not stress the large effects of each homeotic gene through its control of a suite of other genes. A large number of candidates argued that the mutations would be neutral and have no effect and therefore were not needed or useful so therefore would not occur! The concept that mutation is random and spontaneous was clearly lost on these candidates. The fact that homeobox gene sequences are highly conserved across animals is one of the interesting features of these genes and an indication that they are of high importance in ensuring the development of a viable organism with a functioning body plan.

(c) This was well answered with most candidates taking up the opportunity to show their knowledge of apoptosis. This was usually paired with mitosis, differentiation, protein synthesis or respiration. One error that cropped up was assuming that meiosis is important in the development of a frog from a tadpole. Cell division was not a precise enough cell-based process, but mitosis and cytokinesis both earned credit.

(d) Most candidates named fungi or plants, as specified in the specification. One class of error was naming a phylum of animals such as insects and birds. Candidates who answered prokaryotes or protoctista revealed a total lack of appreciation of the central role of homeotic genes in sculpting the body plans of organisms with a large, differentiated body, ie multicellular organisms.

OCR (Oxford Cambridge and RSA Examinations)
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