GCE

Human Biology

Advanced GCE **A2 H423**

Advanced Subsidiary GCE **AS H023**

OCR Report to Centres

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Advanced GCE Human Biology (H423)

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OCR REPORT TO CENTRES

Overview

This series has seen one significant change in the examinations, with an extra 15 minutes added to the examination times for the A2 units F224 and F225. This change was previously announced via a Notice to centres, see
http://www.ocr.org.uk/qualifications/type/gce/science/chemistry_a/

Candidates who stand to gain most from this are those who use the time to read the question carefully and plan an answer to include relevant material.

Two units in this session – F222 and F225 have a large number of candidates who are re-taking the examinations but it was noted than there were some candidates who appeared to be sitting F225 for the first time. Centres are reminded that, while F222 is self contained, F225 will have synoptic content which can relate to the two AS units and to F224. If, for reasons of time constraint, candidates are entered for F225 before they are taught F224, then great care must be taken to ensure that candidates are not disadvantaged. Centres should note how much F224 content was assessed synoptically on this session's F225 exam and take steps to ensure that sufficient material is covered to enable candidates to make these synoptic links.

Understanding and answering the questions

The importance of identifying and implementing the command word in a question has been mentioned in previous reports and there was evidence in F221, F222 and F224 that candidates have improved in this respect. However, as **Q2 (c)(i)** on F225 demonstrates, this is a skill that needs reinforcing throughout the AS and A2. Again, the tendency to 'skim read' was evident with F221 **Q1(b)(ii)** where candidates answered in terms of the adaptations of the capillary rather than the capillary wall, and F225 **Q1(b)** where candidates answered in terms of the effect of the autonomic nervous system on a range of organs when the question was specific to cardiac muscle. Similar problems were seen on F222 **Q4 (c)**. In many such cases, candidate responses contained good biology but the question being asked was not being answered.

All papers contained questions where the action word was 'suggest' and this is generally indicative of a question which is addressing **AO2** for that learning outcome. Centres should note the Principal Examiner comments for F221 regarding the difficulties some candidates experience with **AO2** questions such as **Q5**. The thinking skills required to address this type of question need to be developed – the emphasis on **AO2** is much greater in both the A2 units with principles being tested frequently in a new context. While some element of recall will always be a requirement, the emphasis on this diminishes as candidates progress from AS to A2.

A common feature across the units was the lack of precision in candidates' responses regarding correct terminology. Examples can be seen in F221 **Q1 b(ii)** and F222 **2 d(i)**. It is clear from responses to F225 that Centres tend to assume that candidates are familiar with the meaning of terms such as therapeutic or hypothermia whereas many candidates had difficulty in expressing in precise language what the terms meant. Note also how candidates are still referring to energy being 'produced'.

Dealing with Data

As in previous sessions, there were opportunities on all the papers for candidates to demonstrate their skills in handling and interpreting data, thus meeting some of the **AO3** assessment objectives. Again, some candidates are still not reading graphs accurately or supplying correct units when using data in support of conclusions.

Candidates are expected to describe patterns in data rather than making sweeping statements and it was clear in **Q2 c(i)** on F225 that this skill requires developing. There was a marked difference between countries for some diseases but only a minor difference for others and candidates who failed to distinguish between the scale of the differences failed to gain full credit for their answers.

Mathematical Requirement

The calculation on F225 required candidates to be familiar with how a percentage increase is calculated and proved to be a challenge for candidates. While many are clearly taught to rearrange formulae for calculations of size or magnification, it was clear that the skill did not transfer. The number of decimal places required in a response is either clearly stated in the question or can be deduced from the format of the data provided. Failure to give a response to the correct number of decimal places is penalised and, as on previous sessions, there was evidence that candidates find rounding up or down difficult.

F221 Molecules, Blood and Gas Exchange

General Comments

Examiners were pleased to report that the question paper appeared to be accessible to candidates across the ability range and there was no evidence to suggest that shortage of time was an issue. The overall performance of the candidates in this session showed a relatively normal distribution of marks.

Candidates are showing a greater understanding of command words at the start of a question, but 'suggest' style questions are still proving problematic for many candidates.

Candidates should recognise that, at AS level, examiners will be looking for more accuracy and correct use of scientific terms in their answers. For example, in **Q1bii** stating that diffusion is "easier" was not sufficient and specific reference to rate of diffusion or length of diffusion pathway was required. Furthermore, correct scientific terms should be used and care should be taken to spell these correctly and unambiguously. It is not possible to credit biological terms when they cannot be differentiated from other terms as it is not clear that the candidates are demonstrating understanding of the material being examined.

Candidates are also advised to take care with their writing particularly in questions where the QWC mark is awarded. It is not possible to credit terms towards the QWC mark if two or three letters run together in a word, making interpretation of the intended spelling impossible for examiners.

Calculations continue to cause problems for some candidates and **Q3aii** which required calculation of heart rate from the ECG trace in was not answered well. Candidates should be encouraged to develop a good foundation in and understanding of mathematics as it is a requirement of the specification that these skills are tested on written papers.

Comments on Individual Questions

Q.1 This question was designed to be an accessible start to the exam. Candidates were required to recall knowledge of the tissues in the respiratory system.

  (a) **(i)** The majority of candidates correctly recognised the type of tissue as epithelial, but examiners were looking for greater detail, ie <u>ciliated</u> epithelial tissue.

  (ii) Generally well answered by candidates of all abilities.

  (iii) Many candidates recognised the 'need for energy' but only more able candidates went on to gain a second mark by suggesting why the energy was required, ie for the movement of cilia. It was encouraging to see fewer candidates incorrectly referring to 'energy being produced'.

  (iv) The key to this question was demonstrating an understanding of the key role that mucus and cilia play in removing bacteria and other pathogens. Some candidates used poor terminology, describing the cilia as "hairs" which was not worthy of credit; others considered that it is cilia rather than mucus which trapped the pathogens. Candidates gained credit for stating that the cilia move the mucus up the trachea rather than the ciliated epithelial cells as a whole.

(b) **(i)** The most common error here was again to just state 'epithelium' which was not specific enough gain credit.

(ii) Most candidates recognised that the capillary wall is thin or made up from thin cells, and that this reduces the length of the diffusion pathway. Some candidates contradicted themselves by referring to 'cell walls', which did not demonstrate clear understanding and answers that referred to diffusion being "easier" were not considered worthy of credit. More able candidates recognised that the capillary wall contains fenestrations (pores or gaps was also accepted), although many went on to suggest that these were for diffusion of gases, rather than for the formation of tissue fluid or migration of leucocytes. Reference to the size of the lumen failed to gain credit as this did not answer the question that specifically requested features of the capillary **wall**.

Q.2 In this question, candidates were expected to recall the procedure for measuring blood glucose and then, in part **(b)(ii),** to identify uses for glucose in cells. Part **(b)(i)** required candidates to demonstrate their skills in interpreting a graph.

(a) Generally, candidates were able to achieve at least one or two marking points for this part of the question. However, whilst many candidates seemed to know the procedure, lack of detail frequently let them down, such as not recognising that a lancet (or similar object) is required to prick the skin. Examiners were pleased to be able to award AVP marking points to candidates providing more in depth detail, such as correctly named enzymes, the conversion of glucose to gluconalactone or the generation of an electric current.

Teaching Tip:
Due to the contextual nature of the Human Biology Specification, recall of specific procedures is often required. Candidates should be encouraged to learn procedures in a stepwise fashion as this usually ensures easier recall.

(b) **(i)** Candidates correctly read the question stem as 'describe' and the majority were awarded both marks for this part of the question.

(ii) The majority of candidates obtained one mark for the process, although there were a few incorrect answers stating 'endocytosis' or 'diffusion'. Examiners were disappointed to see that, although many candidates could offer one use for glucose in the cell, few candidates could offer a second use so failed to gain any credit. A number of candidates referred to energy storage or energy production, which is factually incorrect.

Q.3 This question required a good understanding of heart activity and the ability to interpret ECG traces. The calculation in part **(a)(ii)** proved challenging for the majority of candidates who appeared unable to either read the trace correctly or to use the correct mathematical procedure. Parts **(b)(i)-(iii)** showed that candidates had a good knowledge of ECG traces.

(a) **(i)** It was pleasing to see the majority of candidates showing a clear understanding of the sequence of events in the heart as shown by an ECG trace and many were able to use terms correctly. The most common mistakes seen were when some candidates mixed up the valves or thought that the heart was in diastole during the P wave and in systole during the QRS complex.

(ii) This calculation did not perform as well as expected and some candidates gave answers far from the norm (eg a heart rate of several thousand or below 10) yet failed to recognise that such answers could not possibly be in the correct range. A simple measurement between two "P" waves and comparing this against the given scale was required to gain full marks and examiners allowed a range which would take into account candidates using any of the peaks on the ECG trace.

(b) Parts **(i)** to **(iii)** were generally well answered by the majority of candidates.

(c) **(i)** More able candidates with a good knowledge of biological terms performed well on this part of the question. However, less able candidates often got the answers the wrong way round or put the same answer for both, thereby ensuring they were awarded at least one mark.

(ii) This question proved challenging for the majority of candidates and few correct answers were seen. The best answers stated that the wall of the left ventricle had increased in size or that the heart had undergone hypertrophy. However, many candidates merely stated that the heart was "stronger" alone, or "thicker" without making reference to the left ventricle wall or muscle.

Q.4 This question had a relatively high proportion of AO1 (recall of knowledge) marks and so a candidate who had revised thoroughly could answer questions with confidence. Examiners were encouraged by the fact that many candidates appeared to have a good working knowledge of protein biochemistry.

(a) This question was generally well answered, with the majority of candidates gaining at least one mark. Candidates with a poor understanding of biochemistry did not understand the concept here and frequently stated constituent elements (such as hydrogen and carbon) rather than the chemical groups. Reference to 'R group' was not credited since it is not a **named** group.

(b) **(i)** Generally well answered with many candidates recognising that a condensation reaction produces a molecule of water with the loss of OH from the carboxyl group and the H from the amine group. This enabled marking points 1, 2 and 3 to be awarded to those candidates who had shown this clearly in their diagrams. However, marking point 4 was less accessible and candidates often left O atoms lying in between the N-C atoms, similar to an ester bond, despite drawing on other diagrams that the whole OH is removed to become part of the water molecule.

(ii) The majority of candidates could correctly identify the bond between the two amino acids as a peptide bond.

(c) Two marks were easily accessible to candidates who were able to name at least two bonds that are found between the R groups of amino acids with most candidates giving hydrogen bonds and disulfide bridges. Many candidates also recognised that, within thrombin, these bonds are found in the tertiary structure. Correct spelling of the two named bonds would have earned the QWC mark which was generally awarded. It was noted by examiners that some candidates are still incorrectly using 'disulphide' as the spelling for this term and it must be stressed that the current accepted spelling of the bond between the sulfur atoms of cysteine amino acids is 'disulfide'. References to peptide bonds in the primary structure and hydrogen bonds in the (named) secondary structure were ignored. The most common misconception was to describe thrombin as having a quaternary structure which did not gain credit.

Only more able candidates were able to gain further marking points by offering detail about the named bonds or about how they maintained the folding and coiling of the tertiary structure.

Q.5 This question tested the knowledge of enzyme activity and required candidates to explain a graph showing effect of increasing substrate concentration on rate of reaction and then to apply their knowledge to a specific case, ie afibrinogenaemia.

(a) Many candidates correctly described the term 'activation energy'.

(b) **(i)** Many candidates found this question challenging and failed to appreciate the relationship between the substrate and enzyme concentrations. In section **A** of the graph, examiners were looking for comparative statements, eg that the rate of reaction was increasing because more active sites were being filled or more enzyme substrate complexes were being formed. At the point where the rate of reaction becomes constant, in section **B** of the graph, many candidates incorrectly stated that the substrate was being used up even though the graph clearly showed the substrate concentration increasing. As a result, only candidates who understood enzyme-controlled reactions were able to use the correct terms to earn the QWC mark or understand that at each stage either the enzyme or substrate was in excess.

(ii) Candidates who linked the idea that less fibrinogen would mean that less fibrin would be produced generally scored well on this part of the question. The most common error was seen when candidates stated that there would be a lack of or no fibrin produced and so the blood would not clot at all, which showed lack of understanding of the concept of low substrate concentration and its effect on enzyme activity.

Q.6 The word gap-fill in part **(a)** of this question was very accessible to the majority of candidates who showed a good knowledge of erythrocyte structure and function. However, the remaining sections proved challenging with only the more able candidates scoring more than one mark per section.

(a) Whilst the majority of candidates achieved at least three marks on this part of the question, there was some poor spelling of terms. Examiners accepted phonetic spelling when it was unambiguous and could not be confused with other terms. In particular, biconcave was frequently mis-spelt as bioconcave.

(b) **(i)** Very few candidates achieved full marks for this part of the question and some failed to use the data provided which was required for the second marking point. Where candidates did quote figures they failed to give units, ie μm so the marking point could not be awarded.

(ii) This was a demanding question and candidates appeared to find it difficult to provide answers worthy of credit. Whilst many candidates were able to recognise that erythrocytes are biconcave and would therefore have a larger surface area than the value shown for a sphere, few were able to go on to describe that this would change the way in which the calculation had to be performed to work out the **SA:V**.

(iii) It was encouraging to see large numbers of candidates attempting this demanding question. Candidates who recognised what was required of the question offered good suggestions, such as, that a low diffusion rate leads to poor delivery of oxygen to respiring tissues, or that the shape of the spherocytes can lead to a blocking of capillaries.

The most common answer which failed to gain credit was where candidates had stated that there wouldn't enough oxygen in the blood, despite information provided in the question stem stating that healthy levels of oxygen can be maintained by spherocytes.

F222 Growth, Development and Disease

General Comments

While all the questions on the paper were accessible to most of the candidates, marks obtained by candidates ranged from 14 to 85. This suggests that many candidates found the paper challenging. More able candidates were able to display their knowledge and attained high marks across a wide range of topics. The less able candidates had areas of relative weakness although on a few questions, such as **1c**, **2cii, 4d** and **5bii**, their knowledge was very good.

It was pleasing to note that many candidates had obviously studied the pre-release material carefully and were able to use the information to produce some good answers to questions **1** and **2**. Overall there was also an improvement in the interpretation of questions and only some of the less able candidates misread questions and as a consequence failed to gain marks, for example, questions **2ciii** and **4c.**

Many candidates were unable to convert millimetres to micrometres accurately and calculate the size of the HIV particle, as in question **4ai**. Some candidates also lost marks for failing to give the correct units when stating the range of blood glucose concentrations in a non-diabetic and untreated type 2 diabetic, as in question **5ai**. Some lost marks for failing to correctly quote the units when the data is given as number of cases per 1 000, as in question **5bii**.

Poor exam technique was apparent, such as filling the answer lines by rewriting the information in the stem of the question and not including any additional information. This is something that could be improved if candidates were encouraged to read through their answers and make sure they have included some new information. Some candidates are still losing marks by using hybrid ticks and crosses, as in **4cii**.

Comments on Individual Questions

Q.1 This question was based on the case study '**New Ways of Treating Heart Disease' (Case Study 1).** This question was designed to be an accessible start to the exam.

    (a)   **(i)**   Many candidates gained 2 marks for correctly providing two examples of the direct costs of CHD to the NHS. However, quite a few candidates gave two different examples of surgery so only gained 1 mark.

          (ii)   Only the most able candidates gained 2 marks, for describing productivity loss as loss of time at work due to CHD or caring for someone with CHD leading to loss of earnings. Many candidates thought productivity loss referred to the money wasted on treatments that did not work.

    (b)   The majority of candidates got this calculation correct and gained both marks.

    (c)   This question was generally well-answered with most candidates getting at least 2 out of 3 marks for correctly describing the First Aid treatment for a conscious person suffering from a suspected heart attack. A significant number of candidates gained maximum marks with just a few describing the procedure for CPR which is the First Aid treatment for cardiac arrest.

    (d)   **(i)**   Only the more able candidates gained 2 marks for correctly naming two tissues found in the wall of blood vessels. The most common error was to state muscle instead of smooth muscle and epithelium instead of endothelium or squamous epithelium.

(ii) The was a challenging question and only the most able candidates gained 3 marks by stating that progenitor cells, like stem cells, are able to divide by mitosis and differentiate into specialised cells.

(iii) Most candidates gained both marks by stating that the patient's own cells would not be rejected and there was less risk of infection.

(e) Many candidates made the link to the peptides binding to the target proteins and often went on to say that the target proteins were on the basement membrane of the endothelium and so gained the 2 marks. A few candidates did not make this link or went on to say the target proteins bound to lipids in the membrane, which was not credited.

(f) Most candidates gained 1 mark for this question by stating that nanoburrs did not require invasive surgery. Only a few candidates went on to say that there was less risk of damage to the artery or that nanoburrs may act at more than one site. The most common errors were to state that nanoburrs released the drugs more slowly or that nanoburrs released the drugs in a more specific area.

Q.2 This question was based on the case study '**Effective Practice in Blood Transfusion**' **(Case Study 2).**

(a) Most candidates were able to gain 2 marks for stating two reasons why a person may need a blood transfusion. A few candidates missed these marks by giving vague answers, such as 'during pregnancy'.

(b) This question proved to be more challenging than expected. Only more able candidates gained 2 marks for correctly stating that the blood is transfused into veins because the blood pressure is lower and the walls are thinner. Quite a few candidates made references to the veins carrying deoxygenated blood and carrying blood back to the heart which were not credited.

(c) **(i)** Many candidates failed to gain marks on this question as they reused the terms 'blood type' and 'compatibility' from the question stem, instead of describing what these terms meant. Candidates need to be made aware that repeating the information in the stem of the question will not gain marks.

(ii) Similar numbers of high and low ability candidates failed to correctly identify which donated blood was compatible with each of the patients' blood. Many candidates gained 1 out of 4 marks by correctly completing the fourth row, showing that blood group O can be given to patients' with any of the ABO blood groups. A small number of candidates lost marks for using hybrid ticks which were ambiguous and hence not credited.

(iii) This was the first extended answer question and it required candidates to describe what would happen if blood from an incompatible blood group were transfused into a patient. This was a challenging question that was accessible to more able candidates They described how antibodies in the patient's plasma would bind to antigens on the donated red blood cells causing them to agglutinate This would lead to blocked blood vessels and a reduction in oxygen supply to tissues. Many candidates also stated how the red blood cells would be damaged and that the haemoglobin that leaked out of the cells would be toxic in solution. Most candidates gained at least 2 marks for stating that the blood would agglutinate and block blood vessels. Less able candidates made vague reference to antigens and antibodies causing blood to clot and failed to gain any marks. Some candidates misinterpreted the question and described the immune response to a bacteria or virus.

(d) **(i)** Only the most able candidates gained both marks for describing how enzymes digest antigen A and remove it from the surface of the blood cells. Many candidates gained 1 mark for saying that the enzyme cut the A antigen from the surface of the red blood cell.

(ii) The majority of candidates gained 2 marks for stating that temperature, pH or concentration of red blood cells needs to be controlled. Statements suggesting that the amount of blood used needs to be controlled could not be credited.

(e) **(i)** Many candidates referred to aspirin thinning the blood and then went onto state that it slows down or stops clotting and gained 1 mark. Only a few went on to say that it would cause more blood to be lost or delay healing so missed the second mark. The role of aspirin in treating heart disease was not widely known suggesting this is a learning outcome which has been overlooked. Reference to it lowering blood pressure was not credited.

(ii) Most candidates gained the mark for stating there was no chance of rejection.

Q.3 This question, on meiosis, proved to be challenging and discriminated well with more able candidates being able to develop their answers using the correct scientific terms.

(a) Only the more able candidates gained 3 marks for correctly identifying the stages in meiosis. The most common error was to incorrectly identify the stage A as interphase. Quite a few candidates lost marks for failing to state whether it was the first or second meiotic division.

(b) **(i)** The more able candidates gained 7 or more marks out of 9 for describing how meiosis leads to the production of haploid gametes. Less able candidates failed to describe the process in sufficient detail. There was insufficient detail on several stages. Some confused chromosomes and chromatids, others failed to state that chromosomes pair up during prophase 1 and other stages were not accurately described Also, the terms haploid and diploid were not well understood with many candidates stating that the cells produced at the end of meiosis 1 are diploid which is incorrect.

(ii) Most candidates gained both marks on this question.

Q.4 Some parts of this question on the structure of micro-organisms and the use of antibiotics proved to be more challenging than expected.

(a) **(i)** Only the most able candidates correctly calculated the width of the HIV article. Many candidates were unable to correctly convert millimetres or centimetres to micrometres and so could only access one of the available marks.

(ii) This question was poorly answered. The majority of candidates did not know the difference between the structure of HIV and *Mycobacterium tuberculosis*. Some candidates correctly identified the structures found only in *Mycobacterium tuberculosis* and so gained 3 of the 7 available marks.

(b) Many candidates gained this mark for stating that AIDS weakens the immune system and that antibiotics are used to treat opportunistic infections such as TB. Misconceptions were noted such as 'antibiotics are used to kill the virus that causes AIDS' or that 'the antibiotics are used to stop people catching AIDS'.

(c) The majority of candidates gained at least 3 marks for stating that patients do not finish the course of antibiotics and GPs prescribe them when they are not needed. This was sufficient to gain the QWC mark. Good candidates went on to describe further actions of patients and GPs were able to gain maximum marks.

However, many candidates described in detail how bacteria develop resistance to antibiotics which was not relevant to the question and did not gain credit.

(d) This question was well answered and many candidates gained maximum marks. Some candidates lost marks for giving vague answers such as using gloves (needs to be disposable) and washing hands (needs to be with alcohol based hand wash).

Q.5 This question tested candidates knowledge and understanding of type 2 diabetes.

(a) **(i)** Most candidates read the figures correctly from the graph but many did not give units or gave incorrect units ($mmol^{-1}$ instead of $mmol\ l^{-1}$).

(ii) The majority of candidates gained this mark. A few lost the mark for giving vague answers such as early morning instead of a specific time.

(iii) Only the more able candidates gained 2 marks by explaining that people with type 2 diabetics produce less insulin or their tissues are insensitive to insulin and so less glucose is taken up from the blood and converted into glycogen.

(b) **(i)** The majority of candidates gained this mark for defining prevalence.

(ii) Many candidates gained 2 marks for describing the trends shown in the graph but a number of candidates did not gain the figures mark since they did not state that the figures were per 1000 and a few incorrectly quoted the figures in thousands (eg 16 000 for females in 1994).

(iii) The majority of candidates gained at least 2 out of 3 marks by stating that an increase in obesity, less exercise and more sugar in the diet have contributed to the increase in diabetes. A few candidates did not make their statements comparative and therefore were not credited. A small number of candidates stated that there was more type 2 diabetes in men because they ate more and exercised less than women, which was not credited.

(c) Quite a few candidates gained this mark for stating that fruit and vegetables contained vitamins or antioxidants. A small number of candidates made the link to the fruit and vegetables having more fibre and complex sugars so the sugar took longer to be absorbed.

Q.6 This question tested candidates understanding of different types of immunity.

(a) Many candidates got full marks for this question. The most common mistake was incorrect use of the term 'antigen' and some candidates incorrectly put T killer and T helper cells for marking points 2 and 3.

(b) **(i)** Many candidates got the mark for MMR but some did not state all three of the diseases that this vaccine protects from.

(ii) Many candidates stated that more memory cells would be produced but only a small number of candidates went on to state that this would result in a stronger and longer lasting immunity.

(iii) Most candidates gained a mark for stating that herd immunity would be achieved, with some gaining the second mark for stating that it protected the children from becoming seriously ill from the infections.

F224 Energy, Reproduction and Populations

General Comments

This paper was accessible to candidates of all abilities with very few 'no responses' to questions.

The quality of handwriting and spelling was a cause for concern in some cases. It is important to note that if a word is slightly misspelt but sounds correct phonetically then credit will usually be given. However, if a misspelt word could indicate another biological word then exact spelling is required. This was shown in question **4(a)(ii)** where stroma was the correct answer but stoma could not be accepted. Also in order to gain QWC marks words have to spelled correctly.

It is encouraging to see that candidates are focusing on the command words in questions and are able to distinguish between 'describe', 'explain' and 'suggest'. Also they are mindful that the phrase "With reference to Fig..." indicates that there will be a mark available for the use of data, which should always include units.

The overall performance of the candidates showed a normal distribution of marks, with a higher mean mark indicating that candidates were well prepared for this exam.

Comments on Individual Questions

Q.1 This question was designed to be an accessible introduction and tested candidates' knowledge and understanding of the male and female reproductive systems as well as the role of the acrosome in fertilisation.

 (a) Candidates were asked to identify structures shown on a light microscope slide of part of the testis. They were able to identify the seminiferous tubules correctly, but had greater difficulty with the Leydig cells; a large number incorrectly suggesting Sertoli cells. It is worth mentioning that, although credit was given for slight errors, accurate spelling is important.

 (b) **(i)** Candidates were asked to identify various structures in the human reproductive system from descriptions contained in a table. They were usually able to access this part of the question adequately and scored well. Spellings were again somewhat idiosyncratic, particularly that of epididymis.

 (ii) This synoptic question asked candidates to suggest the use that mature spermatozoa made of the sugar fructose and then to explain their ideas. Most were able to gain both marks by stating that the sperm needed fructose to provide energy for movement. It is worth mentioning that a significant number were penalised due to statements that energy was *created* or *produced*.

 (c) In this question candidates were asked to describe the role of the acrosome in the fertilisation of the secondary oocyte. Most were able to identify its position and appreciated that it contains hydrolytic enzymes. Some candidates then went on to describe the action of these enzymes on the zona pellucida. Some candidates wasted time giving correct but, irrelevant, information about the cortical reaction and events post-fertilisation. At A2 level no credit was given for references to eggs or ova.

Q.2 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 recall of knowledge (AO1) marks and so candidates who were well prepared could answer with confidence.

(a) A prose passage concerning the effects of regular exercise on skeletal muscle was supplied with gaps for candidates to fill in with what they considered to be the most appropriate terms. Generally candidates found little difficulty with most sections here, the only problematic one being at the beginning where *surface* area was given instead of *cross-sectional* area. Again, a small but significant number of candidate answers involved the production of energy.

(b) **(i)** Candidates were asked to identify the substituted amino acid found in the beta chain of haemoglobin in Sickle Cell Anaemia (SCA). This proved to be a challenge for a large number of candidates, with answers ranging from the valine (correct) to a large number of other amino acids or genetic codons (some of which were correct) as the candidate had either misread or misunderstood the question.

(ii) In this part of the question candidates were asked to suggest why both normal and SCA haemoglobin remained soluble in the erythrocytes found in the pulmonary vein. Candidates also found this AO2 question challenging with some synoptic knowledge being required from F221. Good candidates were able to answer correctly that the oxygen concentration was high here, but less able candidates put forward a number of ideas from the polarity of both the polypeptide chains and the outer amino acids to the blood pressure and width of the lumen of the blood vessel.

(iii) Candidates were asked to describe the effects of 'sickle cell crisis' and to suggest the symptoms experienced during this. Most candidates made a reasonable attempt to answer this section with varying degrees of success. In a number of cases there was confusion as to what crystallised (haemoglobin) and what became sickle shaped (erythrocytes), but generally this aspect was well covered. Most could also link the change in shape of erythrocytes to their difficulty in passing through narrow capillaries causing blockage. A number of candidates did not appreciate that the problems encountered would be in the small blood vessels so suggestions of blocked arteries and veins were often seen. Many candidates could link these ideas to describe symptoms such as hypoxia, hypertension and pain.

Q.3 This question investigated aspects of Mitchell's Theory of Chemiosmosis and tested respiration in unfamiliar contexts. It required good understanding and the ability to apply knowledge from F221 for candidates to perform well.

(a) **(i)** Candidates were asked to fill in a table containing information about the differing conditions that Mitchell set up to investigate his ideas; the candidates being asked to tick or cross each box depending on whether they thought ATP would be produced. Usually this was well attempted and almost all candidates were able to access at least one mark here.

(ii) Candidates were asked to predict conditions, other than the number of mitochondria, that should be kept constant during testing and to give their reasons for this choice. Most candidates chose temperature and correctly linked this with the effect on enzyme activity. A smaller number chose pH and went on to state that this would also affect enzyme activity or membrane structure.

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(iii) Candidates were asked to give the specific role of oxygen in the mitochondrion. Incorrect answers suggested that it was a proton acceptor, rather than the terminal electron acceptor.

(iv) In this question candidates were asked to name the enzyme used to produce ATP in chemiosmosis. Most candidates had no problems in naming ATP synthase although some mistakenly suggested ATPase.

(v) Candidates were asked to describe the role of the inner mitochondrial membrane (crista) in chemiosmosis. It was usually well answered by many candidates who were able to gain full marks. However some candidates were confused as to where and when electrochemical, proton and concentration gradients were set up. There was also a tendency to digress and refer to ATP synthase and aspects of its action here.

(b) Candidates were asked to outline the mechanism of active transport, including the role of ATP. Most candidates recognised that this type of transport was against a concentration gradient. A minority of candidates suggested that ATP was hydrolysed and very few indicated knowledge of intrinsic proteins. Many incorrectly referred to channel proteins rather than 'carrier' or 'transport' proteins being involved suggesting misconceptions regarding membrane transport carried over from AS.

Q.4 Initially candidates were asked to analyse novel data relating to the light independent stage of photosynthesis. The second part of the question, on the production of an enzyme from molecules of GP, required synoptic material from F221 and proved to be highly discriminatory.

(a) **(i)** Candidates were asked to name the stage of photosynthesis that involves the compounds RuBP and GP. Most candidates were able to answer this correctly by stating, light independent stage or Calvin cycle but a few incorrect answers mentioned light dependent stage.

(ii) Candidates were asked to state precisely where in the chloroplast RuBP and GP are used. Most correctly mentioned the stroma, with thylakoids/grana being the most common errors and stoma gaining no credit.

(iii) Many candidates found explaining why the concentration of RuBP changed between 200 and 275 seconds challenging and related increasing concentrations of RuBP with a need for more to be produced in order to react with the lower levels of carbon dioxide. A good answer noted that RuBP was a carbon dioxide acceptor and that as the concentration of carbon dioxide went down there would be fewer reactions between the two compounds.

Teaching Tip:
Human Biologists are taught about enzymes in the context of blood clotting. Use other enzyme contexts in F224 (the respiratory enzymes, RUBISCO, etc) to re-visit the principles taught in F221.

(iv) Calculations of the rate of fall in concentration of GP between 200 and 350 seconds were largely accurate; some lost a mark for not giving the correct answer to two decimal places.

(b) This question provided candidates with the opportunity to link simple molecules produced in photosynthesis with protein synthesis. There were some excellent and very focused answers to this question, but many candidates were unable to make a straightforward connection, their answers revolving around the Calvin cycle or production of GP or TP in great detail. Some gave a lengthy detailed description of transcription and/or translation, which the question specifically asked them not to do. The link between TP and amino acids formation seemed to be one of the main stumbling blocks.

Q.5 It was hoped that this question would give candidates an opportunity to apply their knowledge of the term 'carbon footprint'. Unfortunately many were unable to do this.

(a) **(i)** Most candidates were aware that a fatty acid contains an unsaturated hydrocarbon chain.

(ii) This question was fairly well answered, with many candidates able to identify that unsaturated hydrocarbons have double bonds between carbon atoms. Some went on to state that this would mean that they would carry fewer hydrogen atoms or that the tails would have kinks in them. A common error was to describe the properties of fatty acids such as their state at room temperature, whereas the question asked for differences in structure.

(iii) Candidates were asked to suggest why the production and use of biodiesel as an alternative fuel might help to reduce the carbon footprint. Many linked this to the reduced production of carbon dioxide and some did relate this to less energy needed in the production of biodiesel as well as less carbon dioxide produced in its production. Some, however, did seem to think no carbon dioxide was produced in the burning of biodiesel which is incorrect.

(b) Most candidates scored both marks for suggesting two ways in which people can reduce their carbon emissions and their awareness was pleasing in such an important area.

Q.6 This question was designed to be an accessible end to the exam but a surprisingly large number of candidates missed fairly straightforward marking points.

(a) **(i)** Candidates were asked to describe the relationship between pregnancy rate (per treatment) and the donor sperm count for IUI treatment. Most were able to state that the pregnancy rate increases as the sperm count increases and also correctly give paired figures with units for both sperm count and rate. Marks were lost mainly for not giving paired figures or units or in a few cases for comparing the figures for IUI with ICI, which was not asked for in the question.

(ii) This question asked candidates to suggest reasons why ICI is less successful that IUI. Most had the idea that the sperm had a greater distance to travel with ICI, but some lost a mark by not making a comparative statement and simply describing the route the sperm would take in either case. Fewer candidates were able to access the second marking point which referred to the hostile environment of the vagina or cervix.

(b) **(i)** Most gained the mark for correctly stating the method used for storing embryos in terms of freezing, usually in liquid nitrogen.

(ii) Candidates were asked to suggest why embryos can only be stored for a limited period of time. The majority of correct answers focused on the reduction in the viability of the embryo with a minority regarding legal limitations. Credit was not given for references to ethical considerations as these would be related to whether embryos should be stored at all.

F225 Genetics, Control and Ageing

General Comments

A small number of candidates enter this unit in January and some excellent answers were seen where candidates were able to demonstrate good synoptic skills showing their ability to link material from F221, F222 and F224 to the areas tested on the paper.

Surprisingly at this level, several candidates misinterpreted the requirements of some questions and, while providing good biological information, did not select information which was relevant to what the questions asked. This was particularly noticeable in questions **1**, **2(c)(i)** and **4(b)(ii)**. In some cases this was due to not reading the requirement of the question, but in the case of **4(b)(ii)**, there is clearly some confusion about what constitutes xenotransplantation.

There was some evidence that candidates had made use of the additional time provided by writing at length and there was extensive use of the additional pages at the end of the paper. However, candidates would benefit from making it clear that their answer continues on these pages. Many crossings out were also apparent on the answer sheets and candidates should be advised to read the question carefully, noting what it requires and to think carefully about their response, rather than just diving in. This is a better use of the additional time now available.

Comments on Individual Questions

Q.1 This question was designed to be an accessible start to the exam. Part **(a)** was intended to be a gentle introduction with a diagram provided. It was clear, however, that some candidates had not thought about the information provided on the diagram. Throughout this question candidates had clearly not read what the question actually required.

(a) In **(i)** the question was about the role of the myelin sheath in transmission of the impulse – not just the role of the myelin sheath. In **(ii),** a few candidates were clearly describing the wrong neurone while in (**iii**) some answers included reference to the myelin sheath.

One common error on this question was to refer to the presence or absence of a 'root' ganglion, indicating that students assume that all ganglia are in the dorsal or ventral roots of the spinal cord and do not appreciate the meaning of the term 'root'.

(b) Candidates who lost marks on this question did so for one of three reasons. Some answered in terms of motor and sensory neurones and wrote generally about homeostatic responses – a misinterpretation of what was meant by the 'two branches of the autonomic nervous system'. Where candidates were aware that it was the sympathetic and parasympathetic nervous system that was required, they confused the actions of the two systems. The other common mistake was to refer to the action of the two systems on several organs rather than just the heart.

Common misconceptions included cardiac muscle being made to contract by the sympathetic and relax by the parasympathetic and more than one candidate wrote that the activity of the Islets of Langerhans was controlled such that the sympathetic triggered the release of glucagon and the parasympathetic the release of insulin.

Q.2 This question assessed AO1, AO2 and AO3 skills where explanations of patterns shown in data were required. There were some synoptic links to F222. Candidates were required to identify parts of the eye and describe and explain patterns shown in a table of data on the causes of blindness.

(a) Most candidates were able to identify all 3 parts of the eye. The commonest error was to identify region **A** as the conjunctiva. Other incorrect answers seen were 'choroid' for **B** and 'pupil' for **C**. Incorrect spelling was not penalised but the spelling of lens 'lense' and sclera 'schlera' suggests some difficulty with terminology.

> **Teaching Tip:**
> Use several different eye diagrams in teaching so that the relationship between the different parts of the eye is clearly understood. Candidates tend to 'learn' one diagram and are disconcerted when the same structures appear in a different view.

(b) **(i)** The term 'acute' is part of learning outcome 2.4.2 (a) in F222 and was tested here synoptically. Fewer than half of the candidates entered were able to state the meaning of this term in a new context.

(ii) This question wanted the effect of glaucoma on vision. Several candidates answered in terms of raised pressure within the eye and damage to the optic nerve. There was some confusion on the part of candidates between the symptoms of glaucoma and the symptoms of AMD.

(c) **(i)** Candidates were asked to describe the pattern shown by the data. Marks were lost where the emphasis of the candidates answer was in explaining the pattern. Data quotes were frequently not given and candidates failed to distinguish between major differences (such as AMD and diabetic retinal damage) and glaucoma – where the differences between developed and developing countries were relatively small. Where data quotes were used, some candidates quoted the figures as 'number of cases' and failed to gain the mark.

(ii) This was answered well by most candidates but, if they had explained in part **(i)** they struggled to provide a different answer here and lost marks.

(iii) This was an AO3 question with candidates expected to use data in support of the statement and go on to provide a scientific explanation for the correlation. A mark was available for candidates who believed the statement could not be supported but a second mark was difficult to obtain.

(iv) Most candidates correctly identified premature death in developing countries as the reason for lower AMD figures but again did not expand on their explanation to gain a second mark.

Q.3 This question related karyotypes and inheritance of Turner's syndrome to an unfamiliar context. Parts of the question were synoptic with F224.

(a) The karyotypes provided for this part of the question were ordered differently but all chromosomes were labelled. Hence it was disappointing how many candidates failed to interpret the second karyotype correctly with some suggesting it was a male with Turner's syndrome and others omitting to state the gender. Reasons were required to support the identification and several candidates stated that there had been a translocation event. This was not credited and indicates that, while non-disjunction is discussed in terms of Turner's and Klinefelter's syndrome, some candidates are not made aware that this is also a cause of Down's syndrome.

(b) This question was synoptic with F224 and the material being tested is normally challenging to candidates. The format of the question made this more accessible with even weaker candidates scoring at least one mark.

(c) The stem of the question separated the hormone treatments and specified which hormone was given at each age. However, only more able students answered in terms of the two separate hormones with many just talking generally about what hormone treatment did and some referring to it as HRT treatment. This made it much harder to achieve the QWC mark. Many candidates wrote at length but answers tended to be repetitive and very generalised, with most pointing out that the hormone treatment would make the girl feel normal but the hormone treatment was being carried out without the child consenting.

(d) **(i)** Again, this was synoptic with F222 and the centromere was identified incorrectly by various candidates as a centriole, chiasma and even as a nucleus.

   (ii) Candidates struggled to express themselves here with the terms 'gene' and 'allele' being used interchangeably. Good answers made reference to genes being missing and hence the proteins coded for by these genes would be missing producing a different phenotype. Many candidates confined their answers to a statement of what the term phenotype meant. Correct biology was given but this was not answering the question.

(e) **(i)** This was done well by most candidates although careless mistakes were made such as not making clear that symbols were gametes and not aligning the correct phenotype and genotype.

> **Teaching Tip:**
> Draw up a set of rules for genetic diagrams such that gametes are separated by commas or put in a circle. Make candidates use the terms 'gametes', 'phenotype' and 'genotype' in their diagrams.

   (ii) This question was an **AO2** question requiring candidates to appreciate the consequences of missing genes. Common misconceptions were that genes on the Y chromosome were more dominant – suggesting a fundamental misunderstanding of sex linkage. Good answers pointed out that there would be no equivalent genes on the Y chromosome and hence the fetus would not be viable.

Q.4 This question related to genetic techniques with some synoptic knowledge of F224 and F222 being required. Most of the marks were **AO2.**

(a) **(i)** The format of this question made it accessible to most candidates although careful reading of the stages was required.

   (i) This was a 'new context' **AO2** question and it was pleasing to see how many candidates correctly spotted DNA ligase as the enzyme. There were some clear 'guesses' with restriction enzymes being the commonest.

   (iii) Although the role of a 'promoter' was explained in the question, weaker candidates assumed that its role was to increase (promote) milk production. Many candidates merely repeated information given in the question.

(iv) Only candidates with a sound synoptic knowledge of F224 correctly identified the hormones of lactation with oestrogen and progesterone being the commonest incorrect answers.

(b) This proved to be a part of the question that candidates found surprisingly challenging with relatively few appreciating that the technique being described would constitute germ cell therapy and would hence be illegal in humans. The most common response which gained credit was reference to the undesirability of 'designer babies' Several weaker candidates answered in terms of the problems of using embryonic stem cells (see **4 c (ii)** below) suggesting that the 'new' technologies such as genetic engineering and stem cell technologies are 'lumped' together by weaker students.

(c) **(i)** Better answers were seen to this part of the question although, for cirrhosis, some qualification was required such as excess alcohol consumption.

(ii) The learning outcome being tested here was 5.1.4c and the majority of marks were **AO1**. However it was rare to find a candidate who responded in terms of the genetic modification of animal cells. As in **4(b)**, many discussed the use of embryonic stem cells – thus missing the point that the question was about non-human organs. This was clearly either a case of careless reading of the question stem or of candidates not being able to distinguish between the various techniques in this section of the specification.

Discussion of ethical issues again tended to be repetitive and vague.

Teaching Tip:
Rather than 'open-ended' discussion on 'ethical issues' use a framework and 'link' issues to different aspects of the framework. A very useful document is published by the Nuffield Council on Bioethics and a review of literature is available. Other useful documents can also be viewed on

www.nuffieldbioethics.org

Candidates need to be discouraged from making sweeping and emotive statements and taught to make reasoned and rational ones and avoid 'trite' phrases such as 'playing God'.

Q.5 This question combined **AO1** questions on the therapeutic uses of cannabis with **AO2** context based questions on kidney function and **AO3** data interpretation questions.

(a) **(i)** A surprising number of candidates could not explain what was meant by the term therapeutic and fell back on the information given in the stem of the question – 'pain killers' was the commonest response.

(b) **(i)** Fundamental skills such as accurately reading from graphs and using the units given on axes need to be re-inforced although the majority of candidates did achieve at least one mark on this question.

(ii) This question was a good discriminator with more able students scoring full marks. As this was an AO2 question on kidney function, candidates who lost marks did so for inaccurate descriptions of ultrafiltration – using the term correctly but then contradicting themselves or grouping the terms 'ultrafiltration and selective reabsorption' together as if they were one process.

(iii) Again, more able candidates appreciated that it was variation in concentration of breakdown product in one subject after one dose that was being described in the graph. Weaker candidates answered in terms of different people having different metabolic activity which could not be credited. Those candidates with a secure understanding of the control of water balance and the role of ADH scored well on this question.

(c) **(i)** This was a demanding question which required candidates to appreciate that was being measured was a breakdown product of the drug rather than the drug itself.

Q.6 This question contained a mixture of AO1 and A02 questions and there were synoptic links to F222 and F221. Most candidates found the format accessible although the calculation proved to be very demanding.

(a) This was an AO1 question and required a concise answer. Weaker candidates made no reference to core temperature and wrote vaguely about getting 'too cold for chemical reactions to occur'.

(b) The symptoms of hypothermia were well known although there was some misconception regarding breathing rate with some candidates thinking it would increase as hypothermia became more severe. Again there was evidence that candidates had not read the question and the answer boxes were completed with correct but irrelevant material.

(c) **(i)** The percentage increase and final figure was provided with candidates required to find the initial figure – a re-arrangement of a form of calculation which has been commonly asked in previous papers across the specification. It was clear that many candidates had no idea how to proceed with many filling the available space with a range of different calculations. This is a format which clearly requires practising.

(ii) This question was a demanding one which required candidates to use their knowledge of the risk factors associated high blood pressure from F222 and they could also use their knowledge of blood clotting from F221. Some excellent answers were seen from well prepared candidates whereas weaker candidates failed to appreciate what was being asked and answered in terms of elderly people not being able to afford heating or having weakened immune systems – correct material but not within the scope of the question.

Q.7 This question required candidates to be familiar with the three forms of HRT. Careful scrutiny of the diagram was required in order to correctly distinguish between the treatments.

(a) Most candidates identified the two hormones correctly but some failed to associate the correct hormone with the correct symbol. There were some surprises such as ADH.

(b) As expected, most candidates could identify the continuous combined method but confused the remaining types.