

Human Biology

Advanced GCE A2 H423

Advanced Subsidiary GCE AS H023

OCR Report to Centres

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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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Overview

This will be the final year for January examinations in any unit. Obviously, there are implications for both AS and A2 candidates. As neither of the AS units are synoptic, the order of teaching the two units is not critical. Given the problems that a number of AS students have with biochemistry, it becomes possible to cover these learning outcomes later on in the year when candidates are more mature. There is also the opportunity to combine learning outcomes from F221 and F222 in one scheme of work - for example, the heart and circulatory systems options from F221 with the coronary heart disease learning outcomes from F222. However, candidates will need to be made aware of the learning outcomes that will be assessed in each exam paper as this will not change. At A2, unit F224 can be synoptic across both AS units while F225 can be synoptic across all previous units including F224. Centres need to bear this in mind when planning the order of teaching at A2.

One common issue this session was the failure on the part of candidates to indicate when additional pages had been used to complete an answer, or to indicate correctly which piece of additional writing corresponded to which question. Examiners are directed to look at every page submitted but since many candidates do not answer questions in the order on the paper, additional material can be confused if not clearly linked to a specific question and candidates risk not being awarded the correct number of marks.

Understanding and answering the questions

The importance of identifying and implementing the command word in a question has been an important part of the literacy strategy in many schools.

Teaching Tip

Emphasise the importance of reading questions carefully by implementing the acronym RE-BUGG: REAd the question, Box the command words, Underline key words, Gauge the number of marks available, Glance over your answer to make sure you answered all parts of the question.

Questions where some candidates would benefit from this approach can be seen on F221 (**Q3a**), F222 (**Q3a**), F224 (**Q5d**) and F225 (**Q1d**).

As in previous sessions, the understanding of key terms and their correct use in responses was a skill which discriminated between candidates across all the papers. In F221 **Q1(b)(ii)** was one such example (fluid mosaic model) as were F222 **Q4(b)(i)** (syndrome), F224 **Q5(c)** (totipotent or pluripotent) and F225 **Q1 (b)** (autosomal linkage) and **Q2 (a)** (gluconeogenesis/glycogenolysis etc.).

Dealing with Data

Marks are still being lost for poor use of data quotes or for inserting the incorrect units or omitting them totally. The graphs provided on the A2 papers (Fig 4.1 on F224 and Figs 2.1 and 5.1 on F225) exposed problems with some candidates unable to pick out the dependent variable(s) and hence experiencing difficulty in describing patterns or relationships. While the questions using data on the AS papers were relatively accessible, candidates should be prepared for more challenging uses of data on F224 and F225.

Mathematical Requirement

Examiners make every effort to vary the type of calculation presented to candidates for the assessment of mathematical skills. On F221, calculations on magnifications are a learning outcome but the calculations asked on F224 (**2 (c)(iii)**) and F225 **2 (c)(i)** required application of the information given or a rearrangement of a formula. Candidates are expected to be able to demonstrate those mathematical skills outlined in the specification and Centres should do more than just rehearse calculations of magnification and size and simple percentage increases and decreases.

F221 Molecules, Blood and Gas Exchange

General Comments

Overall this question paper appeared to be accessible to the majority of candidates and very few questions resulted in 'no response'. There was little evidence to suggest that the candidates struggled for time and many used the additional pages at the end of the paper to complete their responses. However, examiners commented that few candidates indicated that they had used the additional pages and recommend that candidates clearly state their intention to continue their response on the additional pages to guide the examiner.

The overall performance of the candidates showed a relatively normal distribution of marks and candidates demonstrated a wide range of ability with stronger candidates demonstrating a clear grasp of the questions and displaying their knowledge to gain high marks. This suggested to examiners that centres were continuing the good work in preparing candidates for the contextual format of the questions. Weaker candidates need encouragement with reading the questions appropriately and developing their answers to achieve AS level standard, paying particular attention to their use of scientific terms.

As in previous papers there were no obvious misinterpretations of the rubric and Centres should be commended for continuing to stress to their candidates the importance of correctly interpreting the command words and also understanding the contextual nature of the Human Biology specification.

The calculation from the micrograph in **Q3(b)(i)** was well-answered and showed improvement on previous papers. Examiners were also pleased to report that candidates demonstrated the ability to respond to 'How Science Works' style questions as seen in **Q6(b)(i)** and **6(b)(ii)** where there was a requirement to complete a bar chart.

Comments on Individual Questions

Q1 This question discriminated between the candidates with the majority being able to gain credit for parts **(a)(i)-(iii)** but only stronger candidates demonstrating the ability to explain the 'fluid mosaic model' using appropriate terminology.

(a)(i) Generally very well answered.

(a)(ii)–(iii) Generally well answered by the majority of candidates, although examiners reported that some candidates confused lipids and carbohydrates.

(a)(iv) This part of the question was not well answered and it appeared to examiners that many candidates had misread the question due to the large number of candidates incorrectly identifying a protein in their response. This would suggest that they had missed the '**not**' in the statement: 'is **not** made of polypeptide chains'.

(b)(i) It was pleasing for examiners to see candidates correctly using an annotated diagram to describe the arrangement of phospholipids in the membrane and the majority of candidates were able to access at least one mark. However, a few candidates gave poor or incorrect descriptions e.g. hydrophobic 'heads' or hydrophilic 'tails' and even drew them with 'heads' facing into the centre of the membrane. Others failed to gain credit due to the fact that their responses were too brief stating 'heads face outwards' without referring to the phosphate or hydrophilic nature of the 'head'.

- (b)(ii)** Few candidates gained credit for this part of the question and many candidates responded by giving a literal explanation of 'fluid' and 'mosaic' without applying it to the context of the membrane, as they were asked to do in the question. Other explanations were too vague to be worthy of credit, e.g. 'it is able to move' or 'it is made of pieces'.
- Q2** Candidates were required to demonstrate their knowledge of heart structure and the cardiac cycle in this question and whilst the majority of candidates had learnt the topic thoroughly and could access marks, there were some misconceptions evident in the description of the cardiac cycle.
- (a)(i)** Generally, this part of the question was well answered. Although examiners reported the fact that some candidates had rearranged the letters A-D on the answer lines and it was impossible to understand what these candidates had intended, so no marks could be awarded.
- (a)(ii)** A large number of candidates failed to gain credit for this part of the question due to the fact that their responses did not have sufficient detail for the marking point. For example, some candidates just stated 'heart' instead of 'heart **muscle**' or 'supplies blood' without specifying what was being carried to the heart muscle in the blood, i.e. oxygen/glucose/nutrients.
- (b)** Examiners were pleased to report that many candidates were familiar with the cardiac cycle and were able to access this part of the question with many gaining at least three marks and achieving the QWC mark for two scientific terms. However, some concern was expressed that a number of candidates were under the impression that blood travels through the right side of the heart in one cycle then going to the lungs, coming back and going through the left side of the heart in another cycle. These candidates did not seem to realise that both sides of the heart are contracting simultaneously and often marks could not be awarded as a result of referring to the chambers in the left or right sides of the heart throughout their answer.
- Q3** This question required candidates to demonstrate their knowledge of first aid and blood clotting and to apply their knowledge to new situations. The calculation in **(b)(i)** was generally well answered although, whilst some candidates were able to understand the significance of the context in part **(c)**, others struggled to apply their knowledge to protein structure in part **(b)**.
- (a)(i)** As the stem of the question explicitly referred to **reducing blood loss**, generalised first aid statements that could refer to any procedure, such as calming the patient or calling for professional help were not considered worthy of credit in this instance. However, it was pleasing to see responses that suggested looking for any objects in the wound and ensuring it remained in the wound if present. Stronger candidates developed their answers further by describing how the wound could be treated if there was an object present, thereby gaining both marks.
- (a)(ii)** Good responses to this part of the question expressed the idea that the blood clotting process would have begun underneath the first pad, and so if the pad was removed the clotting process would be disturbed. Many candidates referred to additional blood loss being incurred due to the lack of constant pressure being applied on the wound, which was not worthy of credit. Some candidates made reference to scabs being present underneath the pad, which is not consistent with the timeframe of first aid treatment and so could not gain credit in this instance.

- (b)(i)** Candidates had clearly prepared well for this practical application as correct answers were seen across the ability range of the candidates. Some answers were out by a factor of 10, showing that these candidates were not comfortable with converting mm or cm into μm . Examiners would recommend that students should practice these conversions and make measurements in mm rather than cm.
- (b)(ii)** Generally, this part of the question was well answered. The most common incorrect response and possible misconception seen by examiners was 'fibrinogen'.
- (b)(iii)** Candidates were required to recall basic descriptions of the primary and secondary structures of proteins. For some candidates, there was insufficient detail for examiners to award the marking points. In particular, candidates needed to make it clear that they were referring to a single polypeptide chain, and some candidates confused primary and secondary structure with increasing numbers of polypeptides or made no reference to primary and secondary structure being a feature of a polypeptide. It needs to be stressed that the detail of the primary structure is the **order** or **sequence** of the amino acids, not merely the amino acids binding together in a chain. Similarly for secondary structure, examiners wanted candidates to describe how this structure is formed, i.e. by folding, coiling or twisting, and that it is the structure that occurs after the primary structure has formed, so they needed to mention that it is the polypeptide or primary structure that then folds. Some confused answers described the amino acids themselves folding, which could not be credited due to lack of clarity.
- (c)** It was encouraging for examiners to see that candidates had made reasonable and sensible attempts at answering this part of the question, opting for naming particular enzymes in the blood clotting cascade. In this instance, examiners were looking for well qualified answers, such as those including both active thrombin and its substrate fibrinogen, such that their concentration would have been increased at the site of the wound. Many candidates correctly recognised the need for cofactors such as calcium ions but, unfortunately, some omitted "ions" in their response, and so could not be awarded the marking point. Centres are advised to encourage candidates to be precise in their responses involving chemical symbols or to simply write the full chemical name. Relatively few candidates ventured away from the blood clotting enzymes, although a few mentioned that it could speed up the formation of the initial platelet plug by activating platelets.
- Q4** This question tested the candidates' knowledge of the concepts surrounding mucus production and water potential. Candidates across the ability range were able to access marks available particularly in part **(a)**. There is some evidence of incorrect terminology being used for osmosis which was seen in responses to part **(b)(ii)**.
- (a)** This 'gap-fill' part of the question was well balanced with answers of differing levels, so all candidates could achieve some marks. Examiners reported few problems with marking the question as answers required were very specific and it was encouraging to see candidates across the ability range using the correct terms. The only marking point to cause problems for candidates was the mark for 'carbohydrate' as the majority of candidates stated 'glycogen' or 'glucose'.
- (b)(i)** Few candidates achieved the full two marks available for this part of the question mainly as they did not identify that the 'cilia' worked in a coordinated or rhythmic motion. In addition, candidates used incorrect wording for 'cilia' in their answers e.g. cilia hairs, ciliated epithelium cells and ciliated cells. Examiners were disappointed to see references to 'hairs' when describing cilia and Centres should discourage the use of this incorrect terminology at AS level.

- (b)(ii)** Unfortunately, many candidates are still referring to water *concentration* instead of water potential. Other examples of incorrect or imprecise terminology were also seen by examiners e.g. osmotic potential/hypertonic/hypotonic instead of 'water potential', selectively permeable/semi-permeable/partially permeable/membrane/phospholipid bilayer instead of 'cell surface or plasma membrane' and diffusion/facilitated diffusion/exocytosis instead of 'osmosis'.

For this reason, candidates could not gain credit for marking points two or three and few candidates achieved the full three marks available.

- Q5** This question required candidates to demonstrate their knowledge of blood sampling and counting and parts **(a)** and **(b)** were generally well answered. It was encouraging to see that many candidates were familiar with the use of the haemocytometer, although application of knowledge to counting leucocytes instead of erythrocytes proved challenging for some.

- (a)** This part of the question was answered appropriately by the majority of candidates who were able to describe in detail how a blood sample is taken. Some candidates gave responses using terms such as, 'venipuncture' and 'cubital fossa' which demonstrated that some teachers had been encouraging candidates to read in depth. It was generally well answered with the majority of candidates achieving at least two marks and achieving the QWC mark for two scientific terms.

- (b)(i)** Generally well answered with many candidates correctly identifying both leucocytes to gain two marks.

- (b)(ii)** Whilst the majority of candidates appeared to realise that lysosomes had a role in destroying invading pathogens, many were unable to express this correctly in their response. Good responses correctly described the fact that lysosomes contained enzymes for digesting pathogens, but poor responses were also seen where candidates thought that lysosomes were responsible for engulfing the pathogens.

- (c)(i)** Generally very well answered by the majority of candidates.

- (c)(ii)** There were some very good responses seen for marking points one and three and stronger candidates understood the need for a smaller dilution and a stain when attempting to count leucocytes. Unfortunately, the majority of candidates missed out the important part of marking point two (that **only** the erythrocytes would burst or that the leucocytes would remain intact). The most common response seen here was to state that 'the erythrocytes would burst making it easier to see the leucocytes', which was not credited in this instance as it did not quite meet the marking criteria.

- Q6** In this question, 'How Science Works' was being tested and candidates were required to comment on data obtained during an investigation into heart rate.

- (a)** This was a straight-forward question, but lack of precision caused problems for a number of candidates who failed to mention that the artery was used at any point in their answer, limiting the number of marks they could achieve to one. They often referred to locating the 'pulse' in the wrist or neck, which was too vague to gain credit.

- (b)(i)** This part of the question tested the ability of candidates to label axes and although the majority of candidates correctly responded with 'heart rate' or 'pulse rate', many forgot to add the units of 'beats per minute' or 'bpm', so could not be awarded the marking point.

- (b)(ii)** This part of the question was very well answered by the majority of candidates and it was pleasing to see a very low 'omit rate' considering candidates had to draw their answer on a graph.
- (b)(iii)** Examiners reported that it was encouraging to see that a number of the weaker candidates were able to gain at least one mark for identifying that the stroke volume would be higher. Stronger candidates correctly referred to the thickening of the ventricle wall or, indeed, used the term 'hypertrophy'. Some candidates referred to the heart of the athlete in training being bigger or stronger (instead of thicker), which was too vague to be worthy of credit.
- (b)(iv)** The majority of candidates achieved at least one mark for this part of the question by considering a relevant medical condition which was the most common response seen by examiners. It was pleasing to see candidates also referring to gender and duration of exercise to achieve the full two marks. The most common responses which did not gain credit were those which referred to height or weight of the students as examiners were holding out for reference to BMI.

F222 Growth, Development and Disease

General Comments

Some excellent answers were seen and those candidates who had thoroughly researched the pre-release material performed well. AO3 questions proved a challenge for many candidates on this paper but the free response answers were accessible to the majority of candidates.

Comments on Individual Questions

- Q1** This question was based on the pre-release material, and tested a range of abilities. Candidates achieved higher marks if they had thoroughly researched the material provided. This question assessed AO1, AO2 and AO3 skills. For AO3, evidence in support of a conclusion had to be extracted from a data set.
- (a)** There were good responses that recognised that the body proportions or growth rate change as the child grows older. The most common non-scoring answers were vague statements about varying height, weight or diet.
- (b)(i)** Candidates who lost marks on this question did so mainly by referring to the sample size being (too) small, rather than referring to the fact that the sample may not be representative of the population as a whole.
- (b)(ii)** The best answers to this question showed understanding that some obese children (or their families) might refuse to take part. More common non-scoring answers referred to obese children being present in the 9% not surveyed.
- (c)** Nearly all candidates could identify at least one relevant chronic disease linked to obesity, such as CHD. Some candidates did not make the link, and gave other chronic diseases such as COPD.
- (d)(i)** Many candidates could correctly carry out the calculation.
- (d)(ii)** Most candidates gained the mark by agreeing with the statement, and quoting the difference between increase in prevalence boys and girls. Some candidates disagreed with the statement but then gave figures which would agree with the statement. A few failed to state whether they agreed or disagreed.
- (d)(iii)** This was met by a number of candidates. Candidates needed to ensure that their analysis referred back to the percentage figures rather than raw data. Some restated their answer to the previous question, rather than stating a second conclusion.
- (e)** Many candidates correctly explained hypoglycaemia, but some failed to gain credit for unqualified statements about 'low' blood glucose.
- (f)** Candidates achieved high marks when they gave a succinct account of how the (named) immobilised enzyme present in the biosensor reacted with blood glucose to produce gluconalactone. The reaction then resulted in an electrical current being produced which was proportional to the blood glucose concentration. Most candidates gained credit for placing the blood sample on the test strip, and many could correctly name the enzyme. The incorrect spelling of gluconalactone failed to gain credit. A common misconception was that a current was passed through the blood sample.

- (g)** This was a well-answered question. Most candidates knew that families could take more exercise, reduce fatty foods and eat more fruit and vegetables, for example. Some candidates failed to gain credit by giving vague answers about 'healthy diet' without further qualification.
- Q2** This question was based on the pre-release material and candidates achieved higher marks if they had thoroughly researched the material provided. This question was a good discriminator.
- (a)** To gain marks in this question, candidates needed to show an understanding of the information in the pre-release material and then apply it to the question, rather than just restate the pre-release material. For example, candidates were talking about the drugs being more specific (in the PRM) rather than being more effective or successful at treating the cancer. Some candidates did realise that fewer drugs would need to be taken, but did not go on to explain that this would be cheaper (less money wasted on unnecessary drugs) or lead to fewer side-effects.
- (b)(i)** This question tested a spread of abilities. The question asks about the 'detection' of the tumour specific proteins. Only some candidates answered the question in the correct context. Most candidates failed to realise that the protein was an antigen, recognised by macrophages, which then presented the antigens on their surface. The correct B lymphocyte would then be activated. Several candidates did not specify the type of lymphocyte involved, and started their answers with the production of antibodies, rather than giving an account of the *detection* of the protein.
- (b)(ii)** Many candidates gained the mark for T killer cell. A common non-scoring answer was phagocyte/macrophage.
- (c)(i)** This was a well-answered question.
- (c)(ii)** Most candidates gained the mark by stating that embryonic stem cells were totipotent, pluripotent or could give rise to any cell type. Some did not gain credit for just stating that they could become any cell (instead of type of cell).
- (d)(i)** It was encouraging that several candidates could give a full account of semi-conservative replication of DNA, including the enzymes and stages involved. Some candidates muddled it up with proteins synthesis, talking of RNA nucleotides and mRNA. Another error was stating that the process occurred in G2. The QWC mark was also very accessible.
- (d)(ii)** This was a well-answered question. Candidates knew that stem cells differentiated and could become new liver cells. Some knew that they divided by mitosis.
- (e)(i)** The best answers used the pre-release material to explain the use of the drug. A common omission was to realise that only a proportion of women have the protein but not to make the link that only those with the protein could be effectively treated by this drug.
- (e)(ii)** This was well-answered. Some candidates did not gain credit for giving two surgical answers (lumpectomy and mastectomy) or giving radiography instead of radiotherapy.

- Q3** This question mainly addressed AO1 but had some elements of AO2 and AO3.
- (a)** This was well-answered.
- (b)** Many candidates were able to give two correct symptoms of TB. Some candidates failed to score for vague answers about coughing (persistent needed).
- (c)(i)** This question was aimed at higher ability candidates, but was accessed by other many other candidates too.
- (c)(ii)** It was encouraging that a number of candidates were able to analyse at the required level and relate the percentage incidence change to the country's income. Most gained a mark for the incidence increasing in low income countries, but fewer could access the trend mark for decreasing incidence with increasing income. Some candidates digressed and described the social and economic reasons for the data.
- (c)(iii)** Many candidates could give many social reasons for TB spread. The responses from the economic section were often too general rather than clearly stating lack of money for drugs, doctors, or hospitals for example. The term 'ethical' was not well understood. Few mentioned that diagnosis may be seen as a stigma, or lead to loss of job. The QWC was usually accessed by candidates.
- Q4** This question again had elements of AO1 but mainly addressed AO2 objectives. It was a good discriminator.
- (a)** Most candidates routinely scored at least 4 marks from the six available here. The most common errors were for the first two blanks. The question asked for the most suitable term to be inserted. This meant that the correct answer for the first blank space was 'artery', although 'arteriole' was accepted as its diameter can also be reduced. A common error was to put 'blood vessel' or 'capillaries', but these are not the most appropriate term here. A common error for the second blank was 'tar'.
- (b)(i)** The term 'syndrome' was clearly not understood by candidates. Most talked of the cause being genetic, or gave other examples. Only some candidates could give examples of FAS symptoms.
- (b)(ii)** Many candidates did realise that the alcohol crossed the placenta, but talked vaguely of it being 'in the blood' without specifying maternal or fetal bloodstreams.
- (c)** This was generally well-answered. Some candidates also included almost every other test done on pregnant women.
- (d)(i)** Many candidates could carry out the calculation correctly.
- (d)(ii)** Most candidates could correctly name the processes involved. Some candidates did not gain further credit as they talked about cells replicating or dividing rather than clearly stating that the number of cells increased. For apoptosis, cell death is the correct description.
- Q5** Although some AO1 marks were available, the majority of marks on this question were AO2.
- (a)(i)** Most candidates failed to understand that this question was asking for *confirmation* of cervical cancer, such as looking for cancer cells under the microscope, and not its diagnosis. Misconceptions included candidates talking about MRI scans etc, or discussing methods of testing for the general presence of HPV by antibody testing, rather than for its presence inside the cancer cells. Some candidates confused HPV with HIV, and described testing blood for HIV. Some candidates also gave an account of how the virus causes cancer.

- (a)(ii)** Many candidates could correctly quote the relevant data from the graph but some were vaguely talking about ‘more’ cases showing HPV, rather than significantly more.
 - (a)(iii)** Most candidates realised that HPV caused a mutation in the cell’s DNA. They did not realise that the question which asks ‘how’ means that they have to talk about the mechanism involved, i.e. how the HPV causes cancer.
 - (b)** Several candidates misunderstood the question and talked about the consequences of HPV infection, e.g. death or infertility, rather than the risk of its transmission. Some of those who did understand that it was sexually transmitted failed to gain credit as they did not state *unprotected* sexual intercourse.
 - (c)** This was well-answered, with most giving carcinogens (or named) or smoking. Some failed to gain full credit for giving two different carcinogens.
 - (d)** Several candidates were giving general ethical answers about vaccination uptake which were not specific to this situation. Other candidates were talking about young girls not wishing to discuss their sexual activity, or general statements that boys should have the vaccination too, without linking it to reducing transmission. The best answers stated that it might encourage underage sex, or encourage promiscuity.
 - (e)** Although many candidates realised that viruses mutate, the most common misconception was that this led to antibiotic resistance. The best answers talked about the virus antigens mutating and a new vaccine having to be made as the existing one would be ineffective.
- Q6** This question had mostly AO1 marks and some AO3 marks in **6ai**.
- (a)(i)** Most candidates could analyse the data at the required level and make correct statements from the information in the graph. A common error was to not state the units (per 100 000) with any figures quoted.
 - (ii)** Most candidates could quote several risk factors for CHD. Some candidates failed to gain credit for just stating ‘unhealthy diet’, or exercise (not lack of exercise).
 - (b)** This question required the correct scientific terms, correctly spelled, and was targeted at the highest grade. Most candidates scored at least some marks, but incorrect answers included ‘plaque’ (which was ignored) and ‘cardiac arrest’. Candidates should be encouraged to learn the correct spellings for these scientific terms.

F224 Energy, Reproduction and Populations

General Comments

Most candidates applied themselves well and covered all the questions set. There were, as usual, some who did not read the question and in a number of scripts, it became a 'paper chase' to find the continuation of answers. A few scripts were very untidy, with extra comments over-writing previously written answers, often in the margins.

- Q1** Candidates were asked to show competence in data analysis and a theoretical knowledge of how implants functioned, combined with the biological and ethical implications of the 'morning-after pill'.
- (a)(i)** Almost all candidates attempted all parts of this question and almost all gained at least one mark. Most had little difficulty and all marking points were seen. Candidates were aware of the fact that the condom was the least effective method, and many gave relevant figures, although some lost MP2 by not giving units in their answers. Some candidates lost marks because they discussed the benefits of the condom without reference to the table. MP4 was rarely awarded.
- (a)(ii)** Candidates usually gained one mark for commenting on forgetting to take the pill and some of the more able candidates also gave figures or expressed the idea that vomiting would interfere with efficacy. MPs 2 and 5 were very rarely awarded.
- (a)(iii)** This question proved to be more problematic for candidates. Better candidates were aware of the comparative time scales of the two methods and the idea of continuous release for implants. However, many answers tended to be vague with forgetfulness coming in as a possibility. MP2 was rarely seen and MP3 was often incomplete, lacking a comparison. Generally there were a lot of attempts at MPs 1 and 4 with varying levels of success at the latter, often due to poor wording. MPs for this section often appeared in part **(iv)** and vice versa.
- (a)(iv)** Candidates also found this question challenging due in no small part to an obvious lack of understanding of contraceptive methods. In some cases there was confusion between hormone implants and IUDs. The idea of sub-cutaneous implants was usually absent and MP2 was rarely seen. Generally, students lost marks for a 'scattergun' approach to the hormones involved, listing any and all they knew, so MP3 was rarely achieved. Most students gained MP4 for stopping ovulation. Marks were also largely lost for including oestrogen as one of the hormones in the implant and the inhibition of LH as well as FSH.
- (b)** This was usually well-attempted with not too many unqualified 'playing God' answers. All MPs were seen, usually the ethical coupled to comments about short-term effects. A lot of candidates commented upon the 72-hour window of opportunity here. The concept of life starting at fertilisation was probably given by the majority of candidates for the ethical reason.
- Q2** Candidates were asked to identify certain structural components of ATP and NAD from given diagrams and then to describe the differences between them. This was followed by a consideration of the functional role of ATP in terms of energy provision and yield. The question continued with aspects of the provision of ATP by the breakdown of lipids.

- (a)(i)** Well-answered with no major difficulties seen. Adenosine was sometimes suggested for adenine and ribulose or 5C sugar sometimes suggested for ribose.
- (a)(ii)** This section was also well-answered, although some candidates did not give the comparison of ATP to NAD clearly enough in their answers and so lost marks. Many candidates scored full marks though.
- (a)(iii)** Candidates were aware that ATP was broken down or hydrolysed to release energy but less so for the regeneration or continuous aspect, hence, losing this marking point. There were a few candidates still stating that energy is 'produced' or 'made' therefore negating the first MP. Some poorly worded answers caused loss of credit but generally this question was well-attempted.
- (b)** Although most MPs were seen, candidates seemed to find this a difficult question to attempt and a lot of vague comments were given. Marks were gained mostly for giving non-ideal conditions in the cell in terms of pH, and energy lost as heat. Generally one mark was scored.
- (c)(i)** Lots of different, incorrect bonds were suggested, such as phosphodiester or glycosidic bonds. Only a minority of candidates gained the mark.
- (c)(ii)** Facilitated diffusion and active transport were the most common answers. Many candidates lost the mark for the omission of 'facilitated' to describe diffusion.
- (c)(iii)** Many candidates had no difficulties with this, but a significant number, who had problems, failed to give either their working as instructed, or produced a jumble of figures which were unlabelled and therefore not creditworthy. The better candidates made the link between 18 carbon atoms yielding 9 acetyl CoA units and hence 9 x 12 from the information provided in the table. Some made the first stage of the link scoring one marking point, but many were simply unaware of what was required.
- (d)** This question, as expected, proved challenging for the majority of candidates. Candidates scoring full marks were rare. Both MPs were seen, although the first was more common. Many candidates lost marks for this question by over simplifying the answer i.e. saturated hydrocarbons have more hydrogen therefore produce more water, a statement rather than an explanation.
- Q3** This question focused on candidates' knowledge of transcription in the copying of the genetic code for the construction of the polypeptide chains of haemoglobin, the location of the prosthetic groups and the structural importance of the prosthetic groups in oxygen transport.
- (a)** The answer demanded clear thinking, awareness and correct use of appropriate terminology and good organisational skills in presentation. There were many excellent answers, which encompassed all of these. Candidates who knew the process of transcription gave good answers and full marks were accessible. Unfortunately, a large number of candidates failed to read the question and gave unnecessary information about *translation* and protein synthesis, thus wasting their time and effort. The spelling of complementary proved difficult for some and the correct use of technical terms was in some cases a problem. Most were aware of the first stage i.e. unzipping of DNA by helicase, but beyond this, the weaker answers were lacking in exact detail and terminology. Often mRNA bases were used rather than mRNA nucleotides, which lost a marking point and QWC. A pairing with T in mRNA lost further marking points.

- (b)(i)** This question was not well-answered by a significant number of candidates. Many responded to it by suggesting where in the haemoglobin molecule the prosthetic group was attached rather than where in the cell this occurred. This could have been to the result of misreading the question.
- (b)(ii)** Most candidates gained a mark for the reversible binding of oxygen and/or co-operative binding; with MPs 1 and 3 also well in evidence. The structural aspect of this answer, which involved including four haem/prosthetic groups each containing iron, was a point not scored by many – largely for missing out the iron in each haem group. MP4 was rarely seen. It was rare to award 3 marks.
- Q4** This question dealt with issues involved in global food production, ranging from molecular involvement in photosynthesis, to its effect on ecosystems in terms of intensive farming, and finally to loss of agricultural land through rising sea levels caused by increasing levels of carbon dioxide.
- (a)** Candidates were asked to state whether certain named molecules were used or produced in the light independent stage of photosynthesis. Many scored all three points; the main error being that NADP was produced rather than used.
- (b)(i)** This was, surprisingly, not answered well by many of the candidates. Candidates did not seem to appreciate that members of a community interact with the other living elements of the ecosystem and the non-living elements. Many used the terms abiotic and biotic without giving the impression they knew what they meant. For example, there were a number of ‘abiotic organisms’.
- (b)(ii)** This was generally well-attempted and most MPs were seen. Most students responded in terms of pesticides, fertilisers and eutrophication. However, some appear to need guidance as to the causes of the latter, as linkages of causes to effects were sometimes incorrect. Quite a number of candidates stated that pesticides were the cause of eutrophication. Many responses in terms of animal welfare were seen, perhaps due to misunderstanding the question. Some candidates talked about the impact of factory farming e.g. battery chickens or monocultures on the spread of disease.
- (c)(i)** Most candidates were able to outline a relationship between carbon dioxide concentration and sea level and there were only a few candidates who reversed the relationship. Unfortunately a significant number then went on to lose the second mark as they did not include the units when quoting figures in their responses.
- Many candidates missed the figures mark due to reading off the wrong axis.
- (c)(ii)** This was well-answered by most candidates. There were, however, some unusual ideas about sea plants and photosynthesis, dissolved carbon dioxide raising sea levels and increased rainfall adding to water levels. The idea of melting ice in some form seemed to be generally appreciated. The cause was also largely appreciated but marks were lost for vague terms such as global warming rather than the trapping of heat energy by CO₂ or an increase in temperature.
- (c)(iii)** The support statement generally caused few difficulties for students but the second half proved to be much more of a challenge and discriminated well. References to statistical tests were rare and very few of the candidates gave a correct answer concerning overlapping error bars.

- Q5** This question looked at factors involved in IVF, from storage of potentially viable embryos to time lapse before thawing, suitability for implantation and the important features for implantation and successful development of the embryo.
- (a)** All but a very small number of candidates were able to gain a mark for commenting on ice damage to the embryo/cells. Most of the other marks seen were concerned with viability.
- (b)** This generally presented no problems to candidates, although there were some unusual suggestions, including weeks and months. The candidates may have misunderstood the question and were suggesting how long the frozen embryo could be stored for. Of greater concern were the few responses where the candidate obviously did not understand what an embryo represented, since their answers contained the idea that after thawing, the embryo would be fertilised so needed to be viable for this event.
- (c)** This was well covered with most but the least able candidates being awarded a mark for cell division by mitosis. All the other MPs were seen although the term 'totipotent' was not often used. A few candidates were using the term pluripotent as a synonym here. Unfortunately, there were also a noticeable few who had the idea of continued division, but forgot to include 'by mitosis' in their answer.
- (d)** There were some good responses from the more able candidate in terms of both thickening and proliferation. However, many candidates failed to gain this mark as they did not suggest what property of the endometrium was important and some answered in terms of stages in the menstrual cycle without explanation or description.
- (e)** There were some excellent answers to this question and it discriminated well. All the MPs were seen, with most candidates gaining credit for the concept of endometrial maintenance. A small number of candidates had not grasped the fact that there would be no corpus luteum and were suggesting that the hormones would induce this to take over development, as with normal implantation, or that it could be maintained in some way. There were also a large number of references to the suppression of future ovulation by inhibition of FSH.

F225 Genetics, Control and Ageing

General Comments

The paper discriminated well overall and excellent responses were seen where correct terminology was used to provide full and detailed answers (for example responses to **2a**). Questions which are based on interpretation of tables and graphs (**AO3** questions) were done well on this paper. Centres are commended for training their candidates in this skill.

Many candidates made extensive use of the additional page at the end of the paper and additional answer sheets. However, some candidates are still not making it clear that their answer continues on these pages. Some answers that were continued were given the wrong identity e.g. **2 (b) (iii)** being answered but **2 (b) (ii)** written against the additional writing. Examiners are instructed to mark any material which is written but Centres should be aware that such material is at an increased risk of being inadvertently overlooked.

Comments on Individual Questions

- Q1** This question discriminated well. Good candidates were confident in their choice and use of genetic terminology.
- (a)** In **(a) (i)** the term phenotype was well described. A few candidates referred to it as 'a gene which is expressed' which was not accepted. In **(a) (ii)** good responses used the terms genotype and allele correctly and gave relevant examples linked to a named blood group. Some candidates used the blood group symbols as if they were alleles. Some candidates misread the instructions and described how parents with the same genotype could produce offspring with different genotypes and blood groups.
- (b)** Most candidates were able to identify both the stage and the meiosis division in **(i)**. Some only recognised that it was meiosis 1. Similarly most correctly identified locus F in **(ii)**. In **(iii)**, good responses explained the meaning of both 'autosomal' and 'linkage'. Other answers either omitted to state the meaning of autosomal or suggested that the genes were at the same locus. Some candidates implied that the loci were on different homologous chromosomes.
- (c)** This was a 'stretch and challenge' question and synoptic with F224. Few candidates gave protein and RNA as answers although many suggested one of those options. The most common incorrect response given was 'amino acid' which suggests that some candidates still confuse the synthesis of proteins with the synthesis of amino acids.
- (d)** Good descriptions of symptoms were given although some candidates confused macular degeneration with glaucoma. There were many references to closed and open angle glaucoma and the changes in the eye from good candidates. Other candidates focused their answer on either the symptoms or the changes and could not therefore gain full marks.
- (e)** In part **(e)**, good responses linked the failure of the membrane to exclude large molecules and red blood cells from the filtrate to the appearance of proteins in the urine. Some candidates suggested that the membrane would not allow proteins through while others suggested that glucose would appear indicating that the links between ultrafiltration, selective reabsorption and final urine composition are not well understood by some candidates.

Q2 This question assessed A01, AO2 and AO3 skills. There were some synoptic links to F221 (blood glucose as a solute and respiratory substrate) and F222 (factors increasing the risk of colon cancer).

(a) This question discriminated well with good responses using terminology well to describe the action of both insulin and glucagon and the need to maintain osmotic balance in plasma while retaining sufficient glucose to act as a respiratory substrate. Common misconceptions by some candidates were that the hypothalamus was part of the homeostatic mechanisms and also that alpha cells convert glucagon to glucose in response to low blood glucose. Some candidates mis-spelled or confused the meanings of key terms such as glycogenesis, glycogenolysis, glycogen, glucagon and gluconeogenesis.

Teaching Tip:

Issue the 'G' words and their definitions and utilise this as a 'starter' activity - even A2 students would benefit from the occasional spelling test. Constructing 'gap' fills or 'Bingo' based on the same list can vary the type of starter.

(b) This was mainly an AO3 question based on both a table of data and a graph.

(i) Most candidates correctly interpreted this. A few selected an incorrect line but were able to comment correctly on the confidence limits. Some responses tried to explain the trend and this was also seen in part **(ii)**. In part **(ii)** the term 'predicted' was used in the title for the table and could not be credited as an explanation without further comment by the candidate. In part **(iii)** good responses illustrated their answers with quotes from the data provided. Some candidates mistook the BMI ranges for age ranges. In part **(iv)** candidates were required to identify the independent variable in the table. Most candidates spotted the overlapping ranges and the differences between the ranges in the table and those given as line labels in Fig.2.1. Some candidates pointed out that the independent variable on Fig.2.1 was different which was not the question being asked. Some candidates criticised the data in terms of sample selection which was not the question being asked.

(c) The calculation was done well. Some candidates could not re-arrange the formula to calculate the mass for Brown rice. Part **(ii)** was a stretch and challenge question and synoptic with F222 learning outcome 2.1.2(b). While some candidates made the link to the presence of indigestible carbohydrate, very few could connect this to the role of fibre in the colon.

Q3 This question covered a range of learning outcomes on the eye and the nervous system plus aspects of AO3 assessment objectives and 'How Science Works' and overall was a good discriminator.

(a) Many good responses were seen which achieved full marks. Some candidates could not identify the iris and the vitreous humour although most correctly identified the macula and cone cells. Credit was not given where 'rod and cone' was written in the fourth gap. As in previous sessions, some candidates could not identify the relevant parts of the autonomic nervous system. Incorrect spelling was not penalised if the word was unambiguous.

(b) Part **(i)** was done well by most candidates. Some students did not notice that the test was repeated and answered in terms of looking for the same response in both eyes. This information was given in the stem of the question and could not be credited. Good responses mentioned the need to ensure that the response observed was not a 'one off'.

Part **(ii)** was again answered well with most candidates drawing pupils which were both smaller than those shown in Fig.3.1a and both the same size.

(c) This was a 'stretch and challenge' question and performed at this level. Candidates were required to recall that the choroid layer is below the retina and that this layer carries the blood supply which provides the retina with oxygen and glucose. There were some common misconceptions which suggested that students do not appreciate the location of the bipolar and ganglion relative to the rod and cone cells. The two most common incorrect answers were **i)** that the link between the rod and cone cells and the bipolar cell and ganglion cells would be broken or **ii)** that light would be prevented from reaching the retina so an action potential would not be generated.

(d) Most candidates correctly suggested the blink response but answers which described how consciousness is assessed during a first aid emergency were credited - 'Hello, can you hear me?' References to MRI scans were not credited as the question was in terms of an assessment of consciousness level.

Q4 Some candidates annotated the diagram provided of the haemodialysis machine to assist in the planning of their answer. This was good use of the additional time available for this paper and some excellent responses were seen which were well structured and gave a comprehensive account of both how the machine works and how it is used.

(a) While many good responses were seen there were several misconceptions. Few candidates seemed aware that it is arterial blood which is removed although most correctly identified A and its role in the process. Some good responses correctly stated that an anti-coagulant was added by B to prevent clotting and good candidates named Heparin. Other candidates suggested that this was where the dialysis fluid was added to the blood. Many candidates were able to describe the counter current flow of dialysis fluid and blood but only good candidates referred to the presence of partially permeable membranes separating the two fluids, the composition of the fluid and the role of diffusion. The role of D was less well understood. Some candidates answered as if describing the nephron with ultrafiltration occurring at A and selective reabsorption occurring at C and D.

Good responses concluded by commenting on the duration and frequency of treatment. Other responses made no reference to these at all.

(b) This was another 'stretch and challenge' question and was synoptic with F221. Credit was given to those candidates who answered in terms of problems arising with the hardening of artery walls and loss of elasticity. Most candidates responded in terms of blood vessel walls and atherosclerosis which was not credited. The link between high blood pressure and atherosclerosis is frequently misunderstood. High blood pressure is not the result but the cause of atherosclerosis as the endothelium becomes damaged by the increased pressure.

(c) This question was also synoptic with F221 and the role of calcium ions in blood clotting. Some good responses linked the role of citrate to the previous question while others answered in terms of it being a buffer. Where suggestions were biologically or chemically correct credit was given.

- Q.5** This question again mainly addressed AO2 and AO3 objectives with some elements of 'How Science Works'.
- (a)** While most candidates seemed to understand the graph, some had difficulty in expressing themselves clearly and described the pattern in terms of hearing rather than hearing loss. Data quotes were used extensively but units were often omitted.
 - (b)** Good responses discussed the consequences of not being able to hear such as isolation or increased risk in traffic. Other responses described situations such as not hearing relatives or friends but did not extend this to describe the consequences of not hearing.
 - (c)** Most candidates correctly identified the location of the Schwannoma and good responses went on either to state that an MRI or CT scan could be used to confirm this. The most common misconception was to state that a nerve conduction velocity test would confirm the presence of the tumour.
- Q6** Although some AO1 marks were available on part **(a)** and **(c)**, the majority of marks on this question were AO2 and synoptic links were tested from F224.
- (a)** Some excellent descriptions of the release of neurotransmitters were seen. Other responses lacked sufficient detail with the term 'synapse' being used to describe both the synaptic cleft and the synaptic bulb, for example, 'exocytosis releases neurotransmitters from the synapse'. The best responses specified pre- or post-synaptic bulbs or membranes in describing the role of neurotransmitters.
 - (b)** The concept of specificity is covered in several areas and good responses to **(i)** correctly described similarities in shape of heroin and endorphin or how the shape of heroin was complementary to the receptor. Some responses confused the two ideas and suggested heroin was complementary to endorphin. In **(ii)** some candidates confused psychological and physiological dependence.
 - (c)** This question included a 'stretch and challenge' mark - decarboxylases are covered in terms of photosynthesis in F224 so this was a new context. In part **(i)** it was pleasing to see how many candidates correctly identified both substances. Many students spotted that the protein was an enzyme but could not identify carbon dioxide. Part **(ii)** was done well although some candidates confused Parkinson's disease with Alzheimer's disease.
 - (d)** This question was synoptic with F224 and had some element of 'stretch and challenge' in **(ii)**. In part **(i)** while it was clear that many candidates had the *idea* of a triplet code, this was not well described in some responses, for example, 'amino acids are made from 3 bases'. In part **(ii)**, relatively few responses referred to 'introns' and 'exons' although some good responses did refer correctly to 'stop' or 'start' codons and gained credit. A common misconception was that a mutation had occurred.
- Q7** This question had a lot of information in the stem of the question. Many candidates assumed incorrectly that a genetic counsellor would be the only health professional involved and repeated information from the stem of the question in answering part **(a)**.
- (a)** Good responses referred to the supportive role of the genetic counsellor and their role in examining the inheritance pattern of 'family history'. Other responses suggested that the counsellor would be able to 'find out' if the couple were carriers - this was not credited unless qualified by some reference to examining the pedigree chart.

- (b)** Many students correctly identified antigen status, gender and blood group as all being genetically determined. In attempting to explain why, candidates who had chosen antigen status generally picked up the second mark for referring to the need for tissue compatibility. Responses that identified gender tended to talk about sex-linked genetic diseases. As the stem of the question wanted features **other than** genetic diseases, it was not possible to credit a second mark in this case.
- (c)** Many responses tended to be drafted in very general terms with an explanation of what the term 'therapeutic' meant. Credit was given where candidates suggested that tissues were being produced from stem cells for treatment. Several candidates confused 'cloning' with genetic engineering and answered in terms of inserting genes into cells.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Facsimile: 01223 552553

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