

GCE

Human Biology

Advanced GCE **A2 H423**

Advanced Subsidiary GCE **AS H023**

OCR Report to Centres June 2016

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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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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. Relatively few candidates resorted to using the additional space available at the end of the paper.

The distribution of marks was similar to that seen in previous years and candidates demonstrated a wide range of ability. Stronger candidates showed a clear grasp of the questions and displayed 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 exam technique; paying particular attention to their use of scientific terms.

As in previous papers there were some misunderstanding of the rubric, particularly in Q2b and 3d (see section below). Centres should continue to stress to their candidates the importance of correctly interpreting the command words and understanding the contextual nature of the Human Biology specification.

The calculations in Q1(b)(i) and Q5(d)(i) were generally well-answered with the former proving to be very accessible to candidates. The improvement seen on previous papers has been maintained. Examiners were also pleased to report that candidates demonstrated the ability to respond to 'How Science Works' style answers as seen in Q5(b)(ii) where there was a requirement to complete a graph.

Comments on Individual Questions:

Question No. 1

(a)(i) The majority of candidates were able to make a good attempt at this question and few confused the two types of leucocytes. If candidates failed to gain marks it was due to incomplete comparisons such as giving a correct description of the shape of one leucocytes nucleus but not the other. Statements such as 'neutrophils have a granular cytoplasm but monocytes do not' imply that monocytes have no cytoplasm.

(a)(ii) Many candidates recognised that monocytes differentiated into macrophages but relatively few were able to describe their migration to tissues. Many described them as carrying out phagocytosis in blood.

(b)(i) The calculation proved very accessible with most candidates gaining full marks. The most common mistake was incorrect rounding or misreading the figures from the graph.(b)(ii) and (b)(iii) were both answered well with references to electrolytes or ions being the commonest answers in (b)(iii).

(c) While many candidates gained full marks on this question, too many also described protein synthesis - failing to recognise from the stem of the question that the protein had already been synthesised. This was not penalised but did mean that they tended to 'skip' through the actual processing and packaging details. Poor communication was evident with some candidates not describing exocytosis clearly for example 'Proteins are packaged into vesicles and these exit the cell by exocytosis'. This would constitute an incorrect use of the term.

(d) While many candidates were able to identify the problems on the haemocytometer slides, too many merely re-stated the question by saying this would make the count inaccurate without specifying that the numbers of cells counted would be higher or lower.

Question No. 2

Parts (a)(i) and (ii) proved to be very accessible.

On part (b), too many candidates assumed the question referred to the cell surface membrane and it was rare to see any reference to compartmentalisation.

Question No. 3

(a) This was probably the most straightforward question on the paper with the majority of candidates achieving full marks.

(b) Only the better candidates went on to use their knowledge of enzymes and the formation of enzyme substrate complexes to explain the pattern shown on the graph. Weaker candidates concentrated on the graph alone and gave a descriptive answer about lowering activation energy.

(c)(i) There was real confusion about the role of enzyme co-factors in answers to this question, with some candidates describing them as if they were enzymes. Many students gave an example of a co-factor - mostly calcium ions - ignoring the context of the question and not going on to describe the role of co-factors other than in very general terms such as 'needed for blood clotting'. Similarly in (c)(ii) many candidates described warfarin as if it were an enzyme inhibitor and vitamin K was the enzyme.

(d) Some candidates failed to take note of the question stem and answered in terms of the elements present in proteins or the groups present in amino acids.

In part (e) it was pleasing to see how many candidates realised that the change in the enzyme would lead to a change in the specificity of the active site although relatively few went on to use the information in the diagram and refer to the substrates. Very few candidates answered in terms of controlling metabolism and weaker candidates described the change in terms of increasing the concentration of the enzyme as now there would be twice as much.

Question No. 4

(a)(i) Very few candidates picked up on the 'clue' in the diagram which showed the aorta indicating this was the left side of the heart. Hence, although most could identify the atrioventricular valve, few specified it was the left valve.

In (a)(ii) good responses referred to correct data for systolic and diastolic pressure in the chambers of the heart while weaker candidates simply referred to 'blood pressure' or used data from the aorta. Part (a)(iii) was well answered although some candidates did imply that the change in the wall was a cause of the heart defect rather than a consequence of it.

(b) The description of the procedure for an ECG was generally well done. Some candidates did not pick up that the question was about monitoring heart function and described blood pressure readings and pulse rate measurement.

Question No. 5

This topic has been tested several times over various sessions but still descriptions of gas exchange were frequently confused or partially incomplete.

In part (a) candidates still refer to oxygen entering and carbon dioxide leaving the lungs or diffusion into and out of 'the lungs' with no reference to the alveoli as the structure where gas exchange occurs.

Part (b)(i) was a good discriminator with weaker candidates confusing the relationship between the axes ('as surface area increases the volume increases'). The scale on the graph was challenging and allowances were made for this in the mark scheme but too many candidates did not read figures correctly from the graph. Some candidates answered incorrectly in terms of rates of change. Part (b)(ii) was far more accessible although some candidates failed to notice this question and omitted it despite the mark tariff being visible and clear italicised instructions being given.

Most candidates were able to answer part (c) in terms of changes to the ciliated epithelial cells.

Part (d)(i) was a good discriminator with only more able candidates getting the calculation correct and explaining their findings. Common misconceptions referred to changes to tidal volume or vital capacity.

Part (d)(ii) was straightforward for the majority of candidates.

Question No. 6

Part (a) was very accessible.

(b)(i) was well answered but the remainder of this question proved to be more challenging, as have biochemical questions in previous sessions. In part (b)(ii), only a small number of candidates achieved full marks with very few references to either cooperative binding or to reversible binding of oxygen molecules. Weaker candidates referred to oxygen atoms or simply to oxygen. Some good descriptions of tertiary structure were seen although some candidates just listed the bonds involved without saying what these actually did to the protein molecule.

Part (c)(i) was answered well but only more able candidates could describe and, more importantly, explain how glycogen was adapted to its role as a storage molecule.

F222 Growth, Development and Disease

General Comments:

There was a good spread of marks across the ability range. 'No responses' were infrequent and there was no evidence to show that candidates had 'run out of time'.

A lot of very good responses were seen by examiners, particularly to Question 4 and chromosomal disorders as well as cell division in Question 6.

However, the calculations proved problematic and a significant number of candidates failed to assign units when describing trends in data.

Greater care should be given to the use of technical terms. Candidates should also be made aware that correct spelling is essential when there are very similar terms that have a completely different role e.g. beta agonists was often written as beta antagonists.

The following points should be clarified when teaching this unit: there is a genetic predisposition in developing CVD. The lymphocytes that differentiate into memory cells are general lymphocytes that have been cloned from a lymphoblast and effector lymphocytes do not differentiate into memory cells, antibodies present in plasma is a form of passive immunity and by definition does not involve an active response by the recipient.

Comments on Individual Questions:

Question No.1 related to Case Study 1; 25 by 25. This question was answered well although some candidates would have benefited from a more extensive scrutiny of the pre-release material as they failed to grasp some of the contextual data in this question.

(ai) Many candidates were able to gain at least one mark by suggesting either that CVD is easier to treat or that it can be controlled by changing life style. Some candidates stressed smoking in the context of causing CVD without appearing to appreciate that this would also be a leading cause of certain cancers. Thus for a comparative answer, candidates should have concentrated on life style changes that would have a greater influence on CVD mortality reduction. Some candidates felt that cancer could not be treated or that death from cancer was inevitable. Candidates who mentioned genetics felt that cancer had a genetic predisposition but did not appreciate that this also applies to CVD. Thus the mark point for genetic influence was designed to illustrate this in a comparative manner and clarify the greater genetic influence for cancer mortality.

(aii) Thermography and CT-scan mark points were well answered. 'Radio waves' was rarely seen as the correct response for the type of radiation for MRI scans with a significant number of candidates generalising with magnetic or ionising radiation.

(aiii) All mark points were seen in response to this question and it was pleasing to see a number of candidates correctly referring to mutations in proto-oncogenes or tumour suppressor genes. Many candidates correctly stated the insertion of viral DNA but merely stated insertion into a cell, not following through with the genetic material of the cell.

(aiv) Candidates struggled to fulfil the layers required for the mark points although many candidates offered correct part-answers e.g. referred to proto-oncogenes as controlling cell division but did not extend to include that this was done by coding for growth factors. The role of tumour suppressor genes was clearly linked to apoptosis by most candidates although some failed to say this would occur to a damaged cell.

(bi) This was well-answered by most candidates. Some candidates still proffered diet-related answers e.g. reduce salt intake, even though the question stated 'other than diet'. There were many answers referring to health care provision prompted by the reference in the question to different regions of the world, however this was not credit worthy as the answers centred around the NCD framework which the pre-release material stated.

(bii) Candidates made clear reference to an improved system, usually of treatment rather than diagnosis. The majority of answers continued to discuss reasons why morbidity was increasing.

(c) The majority of candidates were able to access the first three mark points to gain credit, but Examiners rarely saw candidates correctly using probability figures from the graphs. Some candidates did not understand the significance of the year 2025 when answering the question and thought that the targets would be met for both men and women as all trends showed a decrease.

(d) This was well answered although a number of candidates mixed up the slow-acting and fast-acting medications. Many candidates referred to brown and blue inhalers in the context of the medication but clearly related this to the correct explanation. Some candidates confused the term bronchodilator with vasodilator.

Question No.2 related to Case Study 2; The Thrifty Phenotype. This question was well answered in part although candidates did not appear to link the pre-release material with the relevant part questions. This was particularly applicable to Q2(b) where very few candidates understood that poor foetal nutrition would cause changes to metabolism, which is stated in the pre-release material.

(ai) The majority of candidates scored at least three marks with the idea of testing for gestational diabetes or immunity to Rubella the most common correct response. Unfortunately, some candidates described these two in detail without outlining other ante-natal advice which restricted their marks. A few candidates did not understand the term ante-natal and referred to care offered to a new born baby and mother.

(aii) The majority of candidates offered ultrasound as a way of monitoring nutrient supply with stronger candidates developing this answer into explaining that this would allow for checking blood flow through the placenta or umbilical cord.

(aiii) This was accessible to candidates of all abilities but omission of the use of a tape measure or the fact that it needed placing around the widest part of the head were commonly seen examples where candidates could not be credited. Candidates did not appreciate that placing tape around the head could refer to any type of tape and not just the measuring kind. Reading answers through before the end of the examination should be encouraged to help spot and resolve this type of simple omission. Some candidates discussed various scanning techniques used for foetal measurements and so had not paid attention to the reference to a new born baby in the question.

(aiv) The majority of candidates correctly stated A for the nervous system but incorrectly responded with C for the reproductive system.

(b) This question proved challenging and whilst the majority correctly suggested Type 2 diabetes, few went on to explain their choice correctly. Candidates described the reasons for Type 2 diabetes and their explanation referred to the fact that it was late onset. Candidates did not appear to relate this question to any information provided in the pre-release material. A few candidates described Type 2 diabetes as a lack of insulin production.

(c) This was generally well answered with most candidates achieving at least one-mark point however many candidates analysed or stated the trends at 2001 and 2009 rather than comparing changes from 2001 to 2009 as required by the question.

(d) For candidates who understood that the question applied to the circulatory system, this was generally well-answered. Unfortunately, a significant number of candidates referred to effects on the respiratory system which was not credited. Some candidates incorrectly thought that tar from the cigarette smoke would 'clog up arteries' and that it was this that narrowed the lumens.

Question No.3 centred on vaccinations and long term immunity. Candidates struggled to correctly link the chronological events that lead to the formation of memory cells and confused many different types of lymphocytes e.g. killer T cells forming memory cells. This question gave equal weighting to AO1 and AO2.

(ai) Most candidates confidently offered a correct statement. Some candidates referred to sex at a young age without being specific with that reference.

(aii) The whole range of marks were awarded here and there were some good responses gaining full credit including the QWC. However, weaker candidates often confused the terms 'clonal selection' and 'clonal expansion'. Candidates often mixed the lymphocytes and failed to use the term differentiation to describe the formation of memory cells. Many candidates also simply described the immune response in its entirety which, whilst gaining some marks, did not fully explain how this would then lead to long term immunity following a vaccination. Extra space was used by a large number of candidates.

(b) It was pleasing to see a good number of correct responses. Monocytes replaced with macrophages was the most commonly seen response that could not be credited.

Question No.4 shifted to genetic disorders and required knowledge of particular chromosomal disorders and foetal diagnostic testing. Most mark points were A01 but both AO2 and AO3 were tested.

(a) This was well answered by most candidates with some candidates even stating a specific type of stain. The spelling of 'colchicine' proved difficult for some.

(bi) Most candidates achieved at least one mark. Mark points 3 and 4 were rarely seen by Examiners but many candidates gained both marks with the first two points. Many answers included the abortion time limit as an evaluation of suitability. Some candidates discussed the methodology behind amniocentesis and karyotyping which deviated from the question.

(bii) Candidates clearly read the information provided for this question part and answered it well.

(ci) This was a straightforward recall for the majority of candidates who were able to complete the rows correctly, although some candidates mixed up Turner's and Klinefelter's and some were unsure of the number of chromosomes in body cells. A few candidates wrote the number of chromosome pairs instead of total number.

(cii) Most candidates were able to state a typical characteristic for each and a wide variety of correct responses were seen. A few answers were too vague e.g. short AND tall but the majority stressed the 'abnormal' nature of the difference.

Question No.5 required analytical skills on very topical, epidemiological data and thus centred around AO2 with maths.

(a) Many candidates understood why the first statement was not valid and could also develop their response further by commenting on the data, but very few were able to gain more than two marks as they could not manipulate the data to support their answer. Some candidates did not appreciate that the World data included the data from West Africa.

(bi) Very few candidates knew how to calculate the mortality rates and of those who did complete the calculation there were some who used an inappropriate number of decimal places. Clearly candidates struggled with working out the values per 100,000.

(bii) The majority of candidates answered this in terms of less health care facilities in West Africa although a few candidates felt the difference was solely due to the difference in population size, not appreciating the relevance of calculating a mortality rate and not relating it to the previous part question.

(ci) There were some good responses seen which demonstrated that candidates were aware of the problems such as the need to create new treatments and vaccines. Answers included a need to know how the virus was spread and how to prevent contaminating others. However weaker candidates considered this simply in terms of wearing protective clothing which was not credited. A few candidates were distracted by the 'recently evolved' part of the question and discussed their answer in terms of the virus constantly evolving and showing antigenic shift/drift.

(cii) Although many candidates stated that antibodies would be present in the plasma they also stated that memory cells would be present and did not appreciate that this is passive immunity. Some candidates felt that memory cells would be present and then would form antibodies when injected into the recipient.

(ciii) Screening for other pathogens was the most commonly seen correct response. Candidates need to be aware of not stating that we are 'screening for the *disease*' which could not be credited.

(d) Examiners saw wide variation in what is considered to be a 'local authority' and credit was given to suitable suggestions. Many candidates read notifiable as noticeable, stating that it is a disease that has clear, definable symptoms or can be spotted quickly.

Question No.6 focused on aspects of cell division, testing AO2. Candidates clearly understood both mitosis and meiosis and the question was well answered.

(ai) Most candidates correctly offered the term 'cytokinesis' as their description. Only a few candidates incorrectly answered in terms of other stages in cell division.

(aii) The majority of candidates correctly stated G1 and described what took place. Unfortunately, very few candidates received both marks as they did not extend their explanation as to the length of time taken.

(aiii) Candidates answered this well.

(aiv) It was pleasing to see many candidates gaining marks for correctly identifying the stages from the images.

(b) Candidates struggled with this question and made general statements, not referring to chromatids in their responses.

Question No. 7 completed the paper with antibiotics and antibiotic resistance. This tested AO1 and AO3. This differentiated well and good candidates gave clear descriptions of the development of antibiotic resistance and could describe the electron micrograph of M. tuberculosis.

(a) The majority of candidates were able to describe how to prevent the spread of resistant strains but there were few good responses for how the resistance evolved. However, many candidates were still able to achieve QWC as they understood that 'mutations' were often involved and that resistant bacteria would 'survive and reproduce'. A few candidates confused antibiotic resistance with antibodies and antigens, seemingly reading antibiotics as antigens, and their answers followed through with the bacteria producing specific antibodies to the antigens. Many candidates discussed the prevention of spread in terms of DOT and not over prescribing antibiotics.

(bi) Weaker candidates often referred to cell wall. Capsid was sometimes seen as an incorrect answer.

(bii) A wide variety of incorrect responses were given to this question. Murein was the most common correct response. Many candidates followed through from their incorrect Q7bi by stating cellulose.

(biii) The majority of candidates achieved this mark; the only error seen was stating a difference seen in lymphocytes without stating the cell type.

(c) This caused quite a few problems for weaker candidates who did not offer a discussion about the 'relative effectiveness' so could not gain credit. Very few candidates referred to the control as a comparative measure and some even discussed it in terms of another antibiotic.

F223 Practical Skills

General Comments:

Many Centres again showed experienced in compiling the moderation samples; using treasury tags to organise tasks in the appropriate order (Qualitative, Quantitative and Evaluative) and including a cover sheet to show the breakdown of tasks and highlighting which were resubmissions. Likewise evidence of internal moderation (where there is more than one teacher responsible for the marking of tasks, it is an OCR requirement and should be made clear to the moderator e.g. through the use of green pen) was demonstrated in many centres. Communication between marker and moderator was made easier in the cases where teachers had used numbered ticks to indicate which marking points had been awarded.

As with previous sessions there have been a number of Centres who had their sample returned for remarking after the initial moderation as this generated an invalid order of merit amongst the candidates in the sample. The purpose of this procedure is to preserve the Centre's rank order of its candidates which is assumed to be the fairest measure of candidates' achievement. When the sample is returned, the Centre is expected to remark the entire cohort so that it comes in line with the moderator's recommendations. The Centre is not told which candidates are the subject of the review since all candidates have to be considered by the Centre, and not just the sample submitted for moderation. Understandably, Centres are disappointed to have their sample returned. However, the moderator provides enough information on the accompanying form to guide the Centre towards which questions or part questions are the source of the difference between the original marking and the moderation process. No further communication is possible between the moderator and the Centre at this stage. After remarking, should a candidate's marks for a particular task now not be his or her best score, then the Centre has the option to submit a different task with a better score. The whole sample must be returned to the moderator so that the moderation process can be completed. The Centre is not obliged to remark the scripts. However, the moderated marks will then be used by OCR to make a decision about the final marks to be credited to the candidates. At this point, without Centre input, some candidates may be disadvantaged as a result of the difference between the Centre and the moderation process. Irrespective of this, the Centre has the option to request a re-moderation of the original sample after the publication of the examination results in August.

Comments on Individual Tasks:

As these tasks all remain live for the duration of the specification no specific details can be given here but generic guidance is given for future reference.

Qualitative tasks

These tasks are generally more straightforward in terms of the practical procedures. Candidates are routinely asked to construct tables in accordance with the guidance given in the Practical Skills Handbook. The same is also true for microscope drawings. Candidates must ensure that they understand the difference between an observation and a conclusion. They should also only draw conclusions based on their own observations (and not theoretical expectations). With respect to biological drawings, candidates should understand the difference between labels and annotations. These are skills that can be taught ahead of the F223 assessments in different contexts so that candidates are confident in these areas.

Quantitative tasks

These tasks assess numerical processing and analysis of data. Teachers should ensure that all calculations are checked before marks are awarded. There appeared to be more evidence of unspotted rounding errors in this session which resulted in differences in marks between the Centre and Moderator. Likewise plotting errors were also more common.

Evaluative tasks

Due to their discursive nature, Evaluative tasks are more discriminating than either the Qualitative or Quantitative Tasks. To that end, only the very best candidates are expected to be able to score highly. This task is the areas where most discrepancies were seen between Centre and Moderator marks. Moderators reported an increase in marks awarded for 'inferred' points which should not be awarded. As with written examination papers, answers must be assessed only on what the candidate has said and markers should be careful not to 'read too much into' the answer. Whereas correct alternative answers of sufficient depth/detail will be accepted, benefit of the doubt should not be used. Centres must ensure that all aspects of a mark point are present before a mark is awarded. In some tasks there are two bullet points required for one mark point; both of these must be evident to gain the mark. With the marking tolerance set at +/- 2 for this unit, such generosity and/or errors can lead to unfortunate outcomes (remark requests due to invalid order of merit and/or downwards adjustments). Centres should note that grade E candidates typically may only score 9 to 11 marks in these tasks.

Any queries should be raised before the moderation submission date via the free Coursework Consultancy service.

F224 Energy, Reproduction and Populations

General Comments

Questions on this paper showed good coverage of all the areas of the F224 specification and gave candidates the opportunity to demonstrate specialist biological knowledge and terminology at an A level standard. The paper also gave candidates the opportunity to give theoretical explanations and evaluations of observations and data provided. A lot of very good responses were seen by examiners, particularly with the Calvin cycle.

The following are points that should be clarified when teaching this unit:

- The phospholipid bilayer is a component of a cell membrane not an alternative term.
- Candidate should be able to calculate percentage increase and decrease.
- If graphs are not gridded in an exam paper it is unlikely that candidates will be required to quote figures as it is difficult to get accurate readings.

Candidates should also be made aware that full spellings of essential reactants or terms are often required in answers, particularly those for QWC questions. The incorrect spelling of bisphosphate given as biphosphate was very common; a term that if correctly spelled would have given many more candidates a QWC mark.

Comments on Individual Questions

Question 1 focused on respiratory biochemistry in terms of initially defining a respiratory substrate, followed by identifying participant molecules and structures involved in oxidative phosphorylation. Candidates were also asked to identify a molecule and explain why anaerobic respiration is less efficient than aerobic respiration in yeast based on the molecular structures of ethanol, carbon dioxide and water. Candidates were told that the energy content of a molecule is based on the number of C-H bonds it contains.

The question tested both AO1 and AO2.

Candidates generally lost the first mark in (a) for references to substance or substrate rather than molecule or compound. A few candidates still lost marks for stating that energy was produced. Many candidates correctly identified possible respiratory substrates as glucose, lipid or proteins.

Oxygen was correctly identified as the final electron acceptor in (b)(i) by the majority of candidates. The inner mitochondrial membrane was also correctly identified as the location of the electron transport chain in (b)(ii) by most candidates. In part (b)(iii) most candidates identified ATP synthase correctly as the membrane bound protein involved in the phosphorylation of ADP. The most common mistake was inorganic phosphate.

Common errors in (c)(i) were ethanal, lactic acid and pyruvate. Anaerobic oxidation was considered by many candidates to be less efficient due to less ATP produced in (c)(ii), based on their theoretical knowledge of glycolysis and oxidative phosphorylation, rather than on the information provided. More perceptive candidates did note that there were C-H bonds present in ethanol compared to none in carbon dioxide and water. Only a very small number of candidates mentioned that more or less C-H are broken.

Question 2 required knowledge about the early stages of fertilisation and pregnancy. Initially the path taken by the male gamete in the female urogenital system was required to be drawn on a diagram, followed by the identification of a specific part of a labelled sperm from a micrograph.

The role of fertilisation in increasing genetic variation was then looked at, followed by identifying a stage of embryonic development, the location of implantation and explaining the symptoms shown by an advanced ectopic pregnancy.

The question tested both AO1 and AO2.

The path taken by the sperm (a) was almost universally correctly. Marks which were lost were for the path either not reaching the fallopian tube or extending into the ovary.

Candidates found identification of the part labelled A for part (b) very difficult, the majority incorrectly labelling it in terms of intracellular components such as mitochondria or microfilaments, rather than the tail or flagellum. The end or the terminal part of the tail was rarely identified.

Candidates either correctly appreciated that gametes were genetically different and that random fusion of gametes took place with only one of many potential sperm effecting fertilisation for (c) or incorrectly focused on events which took place in meiosis prior to fertilisation incorrectly linking genetic variation to crossing over and independent assortment or to the combination of different genes provided by each parent on fertilisation.

Blastocyst was correctly identified in (d)(i) as the stage of embryonic development after approximately five days of fertilisation by most candidates. A few candidates stated zygote or embryo. The endometrium of the uterus was correctly identified in (d)(ii) by the majority of candidates as the precise location of implantation. Very few candidates correctly linked a fall in blood pressure with blood loss in advanced ectopic pregnancy and that an increase in heart or pulse rate served to maintain blood pressure in (d)(iii). The majority of answers described the growth of the blastocyst compressing the blood vessels in the Fallopian tube, causing a restriction of blood flow through and hence the reduced delivery of oxygen and nutrients. Increased heart or pulse rate was required to increase blood flow to supply adequate oxygen and nutrients to the blastocyst. Quite a few candidates also have the misconception that ectopic pregnancy demands more nutrients so there is an increase in blood supply to the Fallopian tube resulting in low blood pressure in the rest of the body. A few candidates even thought that the ectopic pregnancy is not recognised by the body so there is still menstruation and this blood loss causes low blood pressure.

Question 3 was about the factors needed for successful fertilisation, requiring explanations of factors which facilitated the passage of sperm for fertilisation and of clomiphene in enhancing the chances of a successful pregnancy. This involved an initial consideration of the intracellular modification of proteins to form mucins, followed by the mechanism by which ions moved into the cervical mucus, how this resulted in mucus becoming less viscous and why this allowed sperm to travel more easily for fertilisation. The action of clomiphene on the reproductive hormones oestrogen and FSH was analysed.

The question tested both AO1 and AO2.

The majority of candidates were well versed in involvement of the Golgi body, the packaging of mucins into vesicles and their release by exocytosis, gaining the QWC mark for making these points in (a). Many Candidates however did not include the attachment of the carbohydrate to the protein in the Golgi body. A lot of candidates dedicated a large part of their answer to a long and unnecessary description of protein synthesis, which gained them no marks, with the modification part included briefly at the end of their answer. The mark for the vesicles travelling to and fusing with the plasma membrane was also rarely given and often lost for missing the travelling part.

Most candidates gained one, if not both marks in (b)(i) for describing how ions could leave cells, either by facilitated diffusion or active transport and of the relevant accompanying mechanism. A number of candidates did lose a mark for being too vague about channel or carrier proteins being involved, often stating both for one process. Most candidates could explain the lowering of

water potential and movement of water by osmosis in (b)(ii). Although the majority of candidates correctly described that the thinning of the mucus enabled sperm to swim more easily in (b)(iii), many did not link this to increasing the chances of fertilisation thereby failing to score the mark for this question.

In (c) the maturing of more follicles, followed by the release of more secondary oocytes that increased the chances of fertilisation were the three points made by most candidates. Relatively few candidates included the inhibition of FSH release by oestrogen or the fact there were increased levels of FSH. Marks were lost for assuming the binding of clomiphene and blocking of oestrogen stimulated the release of FSH.

Question 4 looked at factors that contribute to improved athletic performance based on the taking of anabolic steroids. Initially the mechanism of their entry into the nucleus was considered. The percentage increase in an athlete's performance who had taken anabolic steroids was calculated from graphical data. Two ways in which anabolic steroids could improve athletic performance were taken into account followed by an evaluation of athletic performance before and after out of competition drug testing was introduced in the late 1980s. The question tested both AO1, AO2 and AO3.

Many candidates knew that steroids are lipid soluble or non-polar and that they entered through the phospholipid bilayer in (a), but some lost the second marking point for not specifying that it was by diffusion. They sometimes lost the first mark for referring to membrane instead of phospholipid bilayer. Only very few candidates stated that steroids cross both the plasma membrane and the nuclear membrane nor the AVP.

Many candidates failed to gain full marks for the calculation in (b)(i), although many gained a mark for correctly calculating the difference between the distances thrown initially and finally. Largely marks were lost for basing the percentage increase on the initial distance thrown of 17m rather than the final distance of 19.6 or 19.7m. Marks were also lost for not giving the final answer to 2 significant figures as requested. The fact that athletes can train for longer periods of time as a result of taking anabolic steroids was stated by most candidates in (b)(ii). Many candidates also knew that recovery time was decreased and erythrocyte production was stimulated. Many answers focused on increased competitiveness and aggression which are not scientifically measurable.

Although many candidates correctly identified a decline in performance after the late 1980s when out-of-competition drug testing was introduced in (c), few succeeded in noting that the reduced levels of performance were still higher than those achieved in 1960 and therefore could not be due to the use of steroids. Evaluative questions require that both sides of an argument are stated. A noticeable number of candidates lost marks by incorrectly relating their answer to testing starting after 1980 and not in the late 1980s.

Question 5 asked about how the impact made by gases present in the atmosphere to global warming could be measured, the production of organic molecules in plants and the value of using eCO₂ in refrigerants compared to those produced from fossil fuels. Initially the reason why water vapour does not contribute to global warming was considered. The value of using CO₂ equivalents was assessed and GWP values were provided to enable the calculation of the mass of CO₂ equivalent to 0.5kg of nitrous oxide. On the basis of GWP values candidates were asked to explain why a small increase in hydrofluorocarbons could act against the benefits gained by the reduction of other greenhouse gases. Candidates were then asked to explain how organic molecules could be obtained from CO₂ taken in by the mesophyll palisade cells of sugar beet plants. Finally a comparison between the efficiencies of eCO₂ refrigerants obtained from waste sugar beet to those obtained from fossil fuels in terms of reducing carbon footprint of a supermarket chain was required.

The question tested both AO2 and AO3.

Apart from relatively few candidates who were aware that water vapour does not accumulate or increase over time in (a), answers were too vague and based loosely on the fact water does not absorb or emit infrared radiation or that it has always been here and is not affected by man's activities.

The idea that carbon dioxide equivalents allowed an easy comparison between different gases or that CO₂ sets a baseline for comparison was largely appreciated by the majority of candidates in (b)(i) and most gained this marking point. Some candidates thought that eCO₂ was a real gas, rather than a measurement unit, and wrote about them being used in photosynthesis and being less harmful than other greenhouse gases. The majority of candidates correctly calculated the mass of carbon dioxide that is equivalent to 0.5kg of nitrous oxide in (b)(ii).

There were some very good answers to (c) where many candidates had clearly linked the very high GWP value of hydrofluorocarbons to the fact that the release of a small quantity of it would offset a large reduction in CO₂ emissions. Although some candidates didn't make clear comparisons, stating that the GWP value of hydrofluorocarbons was higher than the others without emphasising that it had a very high value and simply quoting figures.

A lot of candidates gained two to four marks for (d)(i) mainly for the combining of CO₂ with ribulose biphosphate and for the formation of organic molecules from triose phosphate. Marks gained for the intermediate stages varied. The marking point for the first stage which was the formation of glycerate-3-phosphate from a six carbon intermediate was gained by more candidates than for the second stage which was the formation of triose phosphate from glycerate-3-phosphate with the use of ATP and reduced NADPH. The QWC mark for this question was not obtained to the same extent as question 3 due to the misspelling of ribulose biphosphate and the fact that carbon fixation was rarely given in the answer.

A lot of candidates didn't link the greater efficiency of using eCO₂ to its production from a plant and that it was a renewable source compared to fossil fuels which weren't renewable in (d)(ii). A lot of candidates gave vague refs to eCO₂ releasing less CO₂ to the atmosphere than burning fossil fuels.

Question 6 asked about the advantage of growing legumes to farmers from the point of view of synthesis of nitrogen compounds through nitrogen fixing bacteria in their root nodules, which increased protein synthesis in the plant and therefore its growth and through this increased soil fertility reducing the need for fertilizer. Candidates were then asked to explain how these nitrogen compounds through the mechanisms of decay brought about by bacteria and fungi using extracellular digestion involving deamination, ammonification and nitrification, were returned to the soil. The final part of the question asked candidates to consider the role of cereal crop stubble in the conservation of some bird species.

This question tested both AO1 and AO2.

The idea that legumes naturally fertilise the soil and of a reduced need for fertilisers was widely appreciated by many candidates in (a)(i), who were also aware of the presence of nitrogen fixing bacteria (Rhizobium) in the root nodules, but most candidates did not link this to the formation of nitrogen containing compounds within the plant such as amino acids proteins, RNA or DNA but to nitrates which they released into the soil. Many candidates failed to make a link to the nitrogen cycle and referred to the increased content in water in the soil or increased biodiversity. The majority of candidates focused on two areas, either the involvement of bacteria or fungi in decomposition of dead plant material, or nitrification through the role of Nitrosomonas in converting nitrites to nitrates and Nitrobacter in converting nitrites to nitrates. Ammonification was also frequently stated. There were few, if any, references made to extracellular enzymes.

The majority of candidates were fully aware that the stubble provided a habitat or nesting site for the birds as well as providing them with a food source, which enabled them to answer (b) with confidence.

F225 Genetics, Control and Ageing

General Comments:

Overall this question paper appeared to be accessible to the majority of candidates with each question and part question being answered by at least some candidates. There was little evidence to suggest that the candidates struggled for time and extensive use was made of the additional space available at the end of the paper. Again, while this is preferable to answers in the margin and at the foot of the page, candidates should ensure that each question is numbered correctly.

The distribution of marks was similar to that seen in previous years 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 exam technique; paying particular attention to their use of scientific terms. As in previous papers there were some misunderstanding of the rubric, particularly in Q2b(ii) and 5d(iii) (see section below). Centres should continue to stress to their candidates the importance of correctly interpreting the command words and understanding the contextual nature of the Human Biology specification.

The calculations in Q1(b)(i) and Q2(b)(i) were generally well-answered with the former proving to be very accessible to candidates. The calculation on nerve conduction velocity produced very few correct responses and this was mainly due to candidates not registering that the answer required mm rather than cm. Examiners were pleased to report that candidates demonstrated the ability to respond to 'How Science Works' style answers as seen in Q3(d)(i) with some candidates producing some excellent, well considered responses.

Comments on Individual Questions:

Question No. 1

Overall, this question was probably the most challenging on the paper. In part (a) a surprising number of candidates answered incorrectly with ammonia and amino acids being among the more common incorrect responses.

In (b)(i) the most common mistake was not converting correctly between units while only the more able candidates successfully answered (b)(ii) in terms of merging collecting ducts or increasing volume. Numerous diagrams of the nephron have these 'branches' indicated suggesting that the significance of these is rarely brought to the attention of candidates.

In part (c)(i) it was disappointing to see how many candidates identified ADH and then assigned it to the wrong endocrine gland with pancreas being the most common incorrect response. A number of candidates referred to the anterior pituitary. This issue has occurred in previous sessions - pituitary alone could be credited without reference to posterior but anterior pituitary is incorrect. In (c)(ii) although some candidates did correctly identify microvilli in the proximal convoluted tubule, a large number failed to take into account the scale they were working to as indicated in the photomicrograph. While it is certainly true that various transport proteins would be present in the PCT membrane, they would not be visible on a photomicrograph.

Biochemistry is often a weakness with Human Biology candidates and very few were able to identify carbonic anhydrase in (d)(i). In (d)(ii) although many correct statements were made regarding active transport and ATP, candidates failed to link this to the role of mitochondria in synthesising ATP while in (iii) many candidates did not spot that it was an organ system that was required rather than an organ and answers such as 'lung' or 'medulla oblongata' could therefore not be credited.

Part (e) discriminated well although some candidates did not express their answer to (i) well enough for examiners to be certain which form of diabetes they were referring. Only the better candidates answered (ii) in terms of checking for dehydration or overall water loss. Some candidates responded in terms of monitoring body weight or even BMI, suggesting they had not picked up on the context of the question. This was similar in part (iii) with many other urine tests being suggested such as protein or blood. In part (iv) while many candidates correctly identified the correct patient, only the more able went on to 'use their biological knowledge' to explain the graph in terms of the absence of ADH and the lack of water reabsorption.

Question No. 2

Again, this proved to be a challenging question overall. It was surprising how many candidates gave answers to (a) such as 'sensory' or even 'relay' with 'peripheral' being another common incorrect answer. The learning outcome on the autonomic nervous system had been tested several times previous but Centres are advised to stress that these motor neurones are also peripheral.

Calculations such as that in (b)(i) have not been asked before and it was pleasing to see how many candidates grasped the principle. The commonest answer was '6' where candidates had not converted their measurements to mm but had followed the rubric and given a whole number for their answer and this gained a mark. Part (b)(ii) was not answered well with many candidates who referred to transmission between neurones rather than the transmission of an impulse within a neurone. The synapse is clearly taught well in Centres and candidates were anxious to display their knowledge but answers written in terms of synaptic transmission did not allow candidates to access the full mark range. The use of the word 'stimulus' in the question prompted some candidates to answer in terms of the reflex arc. Even answers which scored full marks struggled to explain how action potentials are propagated and, although many candidates wrote that the refractory period ensures a single direction of travel, few went on to explain how or why that is the case. A common mistake was candidates referring to sodium ions diffusing into the axon membrane. While lack of myelination was the most common correct answer to (iii), it was pleasing to see answers referring to small axon diameters. However, many candidates simply referred to babies being smaller or axons being shorter despite having calculated an NCV at the beginning of the question.

In part (c)(i), although many candidates could explain that 37°C was core body temperature and that the skin would be cooler, too many wrote in very general terms about why it needed to be controlled. The fact that a variable has been controlled is because it would otherwise invalidate the investigation - but that statement applies to any variable. The question referred specifically to temperature and correct answers referred to higher temperatures speeding up the nerve impulse or the diffusion of ions across the axon membrane. Part (ii) proved to be a challenge and, although many candidates were able to refer to neurone damage, several candidates referred to high blood sugar resulting in the production of too much ATP. This misconception has appeared before. Part (iii) again proved a challenging question with too many candidates focussing on the statistics rather than the question which asked for conclusions about nerve conduction velocity. Good candidates spotted that velocity declined in both neurones but not all neurones declined to the same extent, while weaker candidates answered in terms of one nerve being faster than the other.

Question No. 3

This question proved to be very accessible to candidates. Part (a) was done well although some candidates failed to carry the information forward to the next part of the question.

Part (b)(i) was an AO2 question which used the MHC learning outcomes to test basic genetics. This was generally done very well although some candidates did introduce crossovers while others attempted to add or subtract the numbers. In (b)(ii) while many candidates answered in terms of the age of an organ donated from a grandparent, only better candidates could explain why the chances of matching one haplotype would be greater using a parent. General discussions about tissue matching being necessary to avoid rejection were common while too many candidates referred to the genes being the same as opposed to alleles.

In part (c), several candidates misread the question and assumed that it was similarities and differences between the parents and children that were being referred to. Since they had just completed a genetic diagram showing that this does not happen this was disappointing. Many candidates were able to explain how the children could have different blood groups although the term 'heterozygous' triggered some candidates to respond in terms of the AB blood group. The fact that the MHC alleles and the blood group alleles were on different chromosomes was spotted by several candidates but relatively few went on to discuss independent assortment and some referred to crossing over, indicating a basic misconception about which chromosomes are involved in crossover events.

Part (d)(i) was answered well although a failure to refer to the figures correctly was not uncommon among weaker candidates - 1 donor rather than 1 donor per million people. The best responses made their arguments clear using terms such as 'However' or 'On the other hand' to structure their statement. In part (ii) some explanation was required of what a 'better quality of life' was.

Question No. 4

This was one of the best answered questions on the paper with candidates displaying an extensive knowledge of the topic. While this was an AO1 question and intended to be accessible across the mark range, good answers broke down the requirements of the question and discussed the options available for treatments and then went on to discuss the risks and benefits.

Question No. 5

Part (a) was answered well with many candidates achieving full marks. Candidates had been told in the question that the allele was sex linked and given the symbols to choose from.

While many were aware that 'e' would be the allele symbol for the condition, some put a genotype (ee) in (b)(i) and only the better candidates went on to give the correct genotypes for (b)(ii) and (b)(iii).

Part (c)(i) was synoptic and answered well but in (c)(ii), too many answers were given in terms of changing the sequence of amino acids rather than producing a protein with fewer amino acids.

Part (d) was intended to be accessible so it was disappointing how many candidates did not 'spot' reverse transcriptase or the fact that this would be somatic gene therapy. In part (d)(iii) many candidates did not pick up on the question rubric and answered in terms of germ line therapy or ethics. It would be a worthwhile discussion for Centres to have with their candidates as to what makes some genetic diseases targets for treatment using gene therapy while others are not.

Question No. 6

In part (a) while many candidates did answer correctly some just stated 'glycolysis', again indicating a basic misconception as to what constitutes anaerobic respiration and what is glycolysis.

In part (b)(i) although lactic acid was given as an answer, many candidates ignored the instruction to use the figure and failed to spot the damage to the electron transport chain. Part (b)(ii) discriminated well with good candidates using their knowledge of complementary shape and active sites. However, weaker candidates confused which compound would have the active site and what compounds would bind and it was not uncommon to see references to methanol having an active site. Many correctly identified the form of dependency in part (iii) but then gave a general description rather than linking it back to the alleles and the effect on alcohol dehydrogenase activity.

Question No. 7

Part (a) was answered well although vague descriptions to 'blood tests' could not be credited. Some candidates did not pick up on the reference to chronic kidney disease and answered in terms of iron tablets or even transfusions.

Part (b) was answered well although in (iv) a failure to read the stem of the question led to candidates answering in terms of a tissue rather than the cells.

Good candidates were able to apply their knowledge of enzyme action in part (c). It was disappointing to see that some candidates were unaware of how to treat hypoglycaemia. Reference to insulin injections suggests that some of them had misread the term.

In part (d) the most common answers on the role of the DSN included general support, dietary advice and exercise. References to checking eyes, feet, blood pressure and kidney function were rarely seen.

F226 Extended Investigation

General Comments:

Many Centres again showed experienced in compiling the moderation samples; using treasury tags to hold the work together and including a cover sheet to show the breakdown of marks in each Skill area which was appreciated by the Moderators. Some centres showed evidence of internal moderation through the use of green pen (where there is more than one teacher responsible for the marking of tasks, it is an OCR requirement). Communication between marker and moderator by some centres was excellent with annotations showing where some descriptors had been met (both partially and in full). However, some centres didn't follow this good practice and provided limited information for the Moderator.

As with previous sessions there have been a number of Centres who had their sample returned for remarking as the initial moderation generated an invalid order of merit amongst the candidates in the sample. The purpose of this procedure is to preserve the Centre's rank order of its candidates which is assumed to be the fairest measure of candidates' achievement. When the sample is returned, the Centre is expected to remark the entire cohort so that it comes in line with the moderator's recommendations. The Centre is not told which candidates are the subject of the review since all candidates that have been entered in the session have to be considered by the Centre, and not just the sample submitted for moderation. Understandably, Centres are disappointed to have their sample returned. However, the moderator provides enough information on the accompanying form to advise the Centre towards which descriptors are the source of the difference between the original marking and the moderation process. No further communication is possible between the moderator and the Centre at this stage. The whole sample must then be returned to the moderator so that the moderation process can be completed. The Centre is not obliged to remark the scripts. However, the moderated marks will then be used by OCR to make the decision about the final marks to be credited to the candidates. At this point, without Centre input, some candidates may be disadvantaged as a result of the difference between the Centre mark and the moderation process. Irrespective of this, the Centre has the option to request a re-moderation of the original sample after the publication of the examination results in August.

Comments on skill areas:

Centres that used the marking grids provided by OCR showed a closer agreement in marks awarded by the Centre and those supported by the Moderator. Centres who do not use these grids are very strongly advised to do so in future sessions. Different descriptors are of different demand and as such some have several elements that must all be addressed to gain the mark. In some cases Centres awarded marks where only some elements were evident.

Skill A

Descriptors which appear to cause differences in marks were: A3/A4, A7, A8, A10 and A12. For clarification:

Descriptor **A3 (A4)** requires theory from F221 and/or F222 (F224 and/or F225) used to justify a question and/or prediction. Candidates must use key AS (A2) terms appropriately. It is essential that the theory is used to justify the prediction and is not segregated theory ('background theory').

Descriptor **A7** requires the candidates to demonstrate how they have used appropriately referenced material from one secondary source to design an appropriate data collection strategy.

Descriptor **A8**, like A7, requires the candidate to show evidence of how preliminary work (or second source) has been used to inform method. Where preliminary work has been used, data must be given to support this.

Descriptor **A10** is a higher demand descriptor and as such requires several elements to all be addressed. As such Centres should only expect the most able students to gain this mark. The method/procedure should:

- be sufficiently detailed that would allow replication by another student
- clearly state how precise data will be collected
- clearly state how accurate data will be collected
- highlight any areas for care and/or speed needed
- give details of how limitations and sources of error will be minimised
- state how key factors from A5 will be controlled/regulated.

Descriptor **A12** is another higher demand descriptor which is likely to only be attained by the most able candidates. It also has several elements which must all be addressed. The candidate should:

- justify their selection of apparatus
- justify and explain the need and way in which variables are measured and/or controlled
- identify any critical points in strategy e.g. acclimatisation time periods
- explain why their chosen method was selected over others.

Skill B

Descriptors which appear to cause differences in marks were: B5, B9, and B10.

For clarification:

Descriptor **B5** builds on the skills already learnt in F223 and as such requires a 'perfect' table of raw data to be constructed. Centres should note that only the candidate's own table can be marked (not pooled or class data). Elements which must all be met are as follows:

- Raw data table only to be marked
- Informative title present
- All data recorded in a single table (no repeated column headings)
- The table must be ruled with a complete outside border
- Informative column and row headings
- IV in first column
- DV to right of the IV
- SI units for IV and DV only present in the column headings (not repeated in cells)
- All raw data must be recorded to the same number of decimal places.

With respect to B6 & B7 moderators do check calculations and there was evidence that in some centres this had not been checked by the marker(s) prior to moderation.

Descriptor **B9** requires candidates to clearly identify anomalous result in raw data using an appropriate method e.g. ± 2 sd/ $\pm 10\%$ of the mean or interquartile ranges.

Descriptor **B10** again builds on the skills already learnt in F223 and as such requires a 'perfect' graph of processed data to be constructed.

- Processed data is plotted
- Informative title present
- Appropriate type of graph for the data collected:
 - Line graph: plot-to-plot (with ruler) with line not extended beyond first and last plot
 - Bar chart: bars of equal width and spaced
 - Histogram: bars of equal width (assuming equal size groups) and bars touching
- Scaled appropriately – plot area covers 50% of available graph paper
- X and y axes scaled in appropriate increments

- Axes orientated correctly (IV on x-axis)
- Both axes clearly labelled ('mean' not 'average')
- SI units for IV and DV
- All data plotted accurately (\pm half a small grid square)

Skill C

Descriptors which appear to cause differences in marks were: C3/C4, C5, C6, C7, C9/10, C12/C13 and C14.

For clarification:

Descriptor **C3 (C4)** requires theory from F221 and/or F222 (F224 and/or F225) used to explain the conclusions. Candidates must use key AS (A2) terms used appropriately. It is essential that the theory is used to explain the findings and is not just segregated theory ('background theory') or repeated verbatim from the A skill.

Descriptor **C5** requires candidates to comment on the reliability of the raw data of at least two of the following:

- concordancy of raw data
 - size of SD or size of SE for each set of raw data
 - size of range bars
 - size of error bars,
- as well as identifying the most and least reliable raw data set.

Descriptor **C6** again requires candidate to comment on the accuracy of the raw data of at least two of the following:

- the percentage error of pieces of equipment and its effect on the raw data
- how the raw data has affected the trend line
- how close the raw data is to the line of best fit (NB this is not the same as the closeness of the means to the line of best fit/trend line).

Descriptor **C7** requires candidates to discuss the reliability of the data collection strategy/procedure and not the data collected. Candidates should suggest at least two appropriate and significant sources of error (one-off event that affects the single piece of data) which could affect the reliability of the procedure.

Descriptor **C9/10** is often misunderstood. It requires candidates to explain the effect of one of the limitations suggested for C8 i.e. the candidate should discuss the effect on the accuracy and/or precision of the raw data collected (not processed data) e.g. shorter/longer times, higher/lower volumes. Often candidates refer to processed data here which is not appropriate.

Descriptors **C12/13** are often awarded leniently. These are higher demand descriptors and as such require candidates to explain the effect of one of the improvements suggested for C11. The candidate should explain how the improvement is likely to bring data points closer to a line of best fit or bring the trend line closer to the predicted trend line.

Descriptor **C14** is a higher level descriptor and as such Centres should only expect the most able students to gain this mark. Candidates should comment on the validity of the outcome of the investigation by referring to at least two of the following:

- confidence levels in any statistical tests carried out
- the accuracy & precision of the data
- the reliability of the strategy & the data
- sources of error & limitations within the strategy
- reference to appropriate published data.

Any queries should be raised before the moderation submission date via the free Coursework Consultancy service.

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