

Human Biology

Advanced GCE A2 7886

Advanced Subsidiary GCE AS 3886

Report on the Units

June 2007

3886/7886/MS/R/07

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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 syllabus 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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Advanced GCE Human Biology (7886)

Advanced Subsidiary GCE Human Biology (3886)

REPORT ON THE UNITS

Unit	Content	Page
*	Chief Examiner's Comments	1
2856	Blood, Circulation and Gaseous Exchange	5
2857	Growth, Development and Disease	9
2858/01	Case Studies	12
2866	Energy, Control and Reproduction	16
2867	Genetics, Homeostasis and Ageing	21
2868	Extended Investigation in Human Biology	27
*	Grade Thresholds	33

Chief Examiner's Comments

This examination series saw an increase in entries at AS and A2 and also saw an increase in the number of centres at AS. This shows that the specification continues to be well received; candidates and teachers are clearly enjoying the context-based approach and are finding the topics to be stimulating. The thorough learning of the content of the specification shown by many of the candidates has made it possible for them to achieve their full potential. We would like to congratulate Centres on this positive approach. In particular, in this series very high quality responses dealing with procedures and health promotion were seen.

As ever, great care was taken to ensure comparability between Human Biology and Biology. The standard of response required by the mark schemes was in close alignment between the two qualifications. This of course means GCE A level Human Biology will never be 'an easier route' and ensures candidates gaining success in GCE A level Human Biology have earned a qualification of equal value to GCE A level Biology.

The candidature included many candidates resitting from previous sessions (especially units 2856 and 2866). This strategy is well informed as it allows candidates to improve their UMS scores. There was, however, evidence that many of these candidates did not show improvement – especially for those resitting 2856 from January 2007. Teachers may be advised to judge more critically whether candidates are best served by resitting 2856 in their AS year.

This series saw an increase in candidates incorporating into their responses information they had gained in other GCE A levels notably PE and Psychology. Examiners will always credit factually correct material that addresses questions set. However, candidates tend not to be selective and instead write large amounts of irrelevant information which examiners are unable to credit.

It was clear that weaker candidates were losing marks with great regularity due to their quality of written expression and it may be the case that teaching time could usefully be spent developing this area. Examiners felt that candidates probably did understand the biology being tested even though their responses did not provide sufficient clarity to award the marks.

Teaching tip

Weaker students benefit from high levels of repetition and reinforcement. Starter and plenary activities can be used to provide frequent recaps of previously covered material. Key terms and definitions can easily be recapped with matching exercises. These can be easily made for intranets with hot potatoes software <http://www.halfbakedsoftware.com>

Understanding the questions

As an Advanced Level Science, Human Biology requires an appropriate standard of literacy, which includes the specialist vocabulary associated with the learning outcomes. This specification emboldens certain terms indicating that they are words that candidates should learn definitions for. This however does not preclude questions being set on terms named but not emboldened within the specification.

The endorsed textbook covers the specialist terms used in the specification as does any good dictionary of biology. Good definitions can usually be found at en.wikipedia.org

Teaching tip

Encourage candidates to build up their own glossaries of words from the specification.

Report on the Units taken in June 2007

Candidates showed good responses to questions that demanded straight recall or to explain information provided. However, when questions required candidates to apply their knowledge to specific situations they produced much poorer responses.

This series provided evidence again that candidates find it very difficult to give what can be deemed as 'generic' biology when set a question based on a specific scenario. An example of this would be 2856 Question 6(a).

Candidates continue to find it difficult to make comparative statements and this was seen particularly in 2866 Question 4(a).

There was evidence that candidates did not always read the questions properly. Candidates in some instances failed to read prompt material even when it was essential for the proper understanding of the question.

Rubric infringements were common on questions asking for a certain number of responses or a tick in a box. Centres and candidates should be aware that marks can only be lost never gained by failing to follow the rubric of a question.

Teaching tip

As this specification is now established there are more past papers available than before. These can be used to help students develop the reading and comprehension skills required. Attention should be given to training students to follow rubrics.

Information, Figures, Tables and Graphs

In general, the data questions this series were handled well by candidates. Questions with figures were also generally done well but a surprising exception was seen by the examiners of unit 2857 where an outline diagram of HIV was presented. This question showed candidates lack of understanding of basic viral structure.

Teaching tip

Teachers would be well advised to practise very basic skills such as labelling simple diagrams of cells and organelles.

Mathematical requirements

The mathematical questions in this series were answered better than in previous series. Centres are reminded that the mathematical skills required by candidates are given on page 89 of the specification. As such, these specific skills are likely to be tested on theory papers at the appropriate level. Candidates are not required to remember complex formulae but are required to be able to use them appropriately.

mathematical skill	competence achieved (✓)
recognise and use expressions in decimals	
recognise and use expressions in standard form	
use ratios	
use fractions	
use percentages	
make estimates of the results of calculations (without using a calculator)	

Coursework

Coursework is an essential component of this specification. Many centres are proving that suitable coursework that enables candidates access to the higher marking points can be set on human studies but it should be noted that these are the exception not the rule. Too many centres are still setting inappropriate coursework tasks and therefore limiting the marks their candidates can access. OCR offers a coursework consultancy service for centres whose coursework marks have been changed by the moderation process. This service is free of charge. Where appropriate, a visit from an OCR representative can be organised to help guide teachers in delivering coursework that enables their candidates to maximise their scores.

Presentation

Diagrams are acceptable parts of a candidate's response but should **always** be labelled. Centres should encourage candidates to use diagrams when they feel they are more effective than words alone. Examiners will apply the mark scheme to labelled diagrams for all questions and some candidates would benefit from greater use of diagrams in their responses.

Candidates should be dissuaded from writing an extra line in-between every dotted line as these are especially difficult to read. Bullet points are an acceptable strategy for answering some types of questions, but the meaning of what is written should be clear, rather than a simple list of one or two word statements.

The language of written responses for questions requiring extended writing at times led to candidates failing to score marks. Examiner can only give credit for what is presented to them. It is therefore important that candidates can communicate their ideas clearly in writing. Although examiners are aware that centres are continually aiming to develop their candidates written communication skills, it is still an area of weakness and should be given due attention in the delivery of this course.

INSET

OCR is offering a full programme of expos and training events introducing the new GCE A level specifications for first teaching September 2008. Further details are available from the OCR website www.ocr.org.uk.

OCR is offering a programme of in-service training for teachers on the delivery of the specification during the Autumn 2007 and Spring 2008 terms. The booklet containing details of these INSET courses arrived in centres during the Summer term 2007. This booklet contains full details of the courses listed below and will also be available on the OCR website (www.ocr.org.uk). Alternatively further information may be obtained by telephone (0121 628 2950).

2856 Blood, Circulation and Gaseous Exchange

General Comments

Candidates achieved a wide range of marks for this paper. It was pleasing to see that even where candidates were struggling, there was evidence that they were interested in the subject matter. Candidates were able to access all questions on the paper, with few areas proving inaccessible. The teaching of this unit had clearly prepared the candidates well and they were, almost without exception, able to display the knowledge they had. There was no evidence that candidates were running out of time.

Human Biology candidates continue to find it difficult to deal with questions which demand a 'generic' response but are set in a 'specific' context. Question 6 (a) typified this.

Candidates did not always seem aware that the tariff of questions should be reflected in the quality of responses given. For example, examiners saw very good candidates give one reason or explanation where two were required. A good example of this would be Question 1 (a)(iii).

Explaining the role of surfactant in preventing RDS or its absence in causing RDS was poorly answered by nearly all candidates and this is the second summer series where a question requiring the understanding of the properties of water has been poorly answered. Centres are advised that this area is not well understood by candidates and more emphasis in schemes of work may be useful.

The long answer question was well answered by most candidates. It was apparent that some centres had given less attention to the use of stethoscopes than others. Centres are reminded that this specification regularly tests the procedures detailed in the specification and candidates should be prepared on all of them.

Teaching tip

This unit has a very extensive list of testable learning outcomes. Constantly encouraging students to take ownership of their own learning and to mark off each learning outcome when it has been covered can help develop an awareness of the amount of content to learn in this unit.

Comments on Individual Questions

- 1 Most candidates found this first question accessible and were able to demonstrate a good level of knowledge about tuberculosis.
- (a) (i) The answer to this question required straightforward recall and the majority of students were able to correctly identify bacteria as the type of organism, with some stating the genus and species name *Mycobacterium tuberculosis*. However, there were still a fair number of candidates who thought that a virus was responsible.
- (ii) This question was generally well answered with the majority of candidates scoring 2 marks by describing the increase to 2001 followed by a decrease in 2002.

Teaching tip

It is worthwhile teaching students the skill of identifying and correctly stating figures in such questions, as there is usually at least 1 mark to be gained by quoting and using figures from the table supplied.

- (iii) Most candidates were able to score 1 or 2 marks on this question by correctly suggesting reasons for higher notifications in London, but there were few that offered an answer for the explanation mark, which required an understanding of the mode of transmission of the TB bacterium.
- (b) The majority of candidates were able to score at least one mark for this question by either stating the importance of antibiotics or the need for a 'long course' of treatment. The main misconception was that many candidates considered that 'vaccination' could be offered as part of a treatment programme, suggesting that candidates did not fully understand the concept of vaccination in immunity and prevention of the disease.

Teaching tip

Unit 2856 has more than one learning outcome which requires students to learn the names of drugs required to treat specific conditions. Produce a matching exercise for named drugs and the conditions they are used to treat, as a revision exercise.

- 2 (a) This was set as a demanding question and aimed at the more able candidates. Only the most able candidates were able to link a process requiring ATP, such as active transport, with respiration in the mitochondria and the demand for oxygen, despite all these elements being present in 2856.

Teaching tip

Encourage the most able students to explain the links between different learning outcomes within 2856.

- (b) The OCR endorsed textbook covers this section well and candidates responded well to this question. It is unfortunate that the words 'membranes' and 'walls' are still confusing to many candidates.
 - (c) Many candidates correctly identified that the surfactant would not be present, though fewer candidates were able to explain the significance of this. Examiners saw many references to friction rather than surface tension. Centres are advised to emphasise the **high** surface tension as being the important property of water - not simply that water has a surface tension.
- 3 The more able candidates clearly enjoyed this question and easily picked up all 8 available marks. It did, however, discriminate between the less able candidates, with the name of the bonds proving to be the least accessible mark. There was some evidence that weaker candidates were 'guessing' between hydrolysis and condensation as the type of reaction involved and it was clear that many weaker candidates did not have a clear understanding of which type of reaction involves the removal of water.
- 4 Some candidates had clearly prepared well for this question and the mark scheme allowed them to gain most of the marks available. It was pleasing to see many well-ordered responses clearly detailing the procedure and then dealing with the information that could be provided. It was evident that many candidates did not know enough about the topic for such an extended question and rather 'ran out of steam in their answers'.

Where procedures such as this are examined, a level of precision is required to gain the marks. Therefore, 'place on top of the heart' was a common imprecise statement that did not gain credit. The OCR endorsed textbook gives a reasonable level of detail for most of the procedures in unit 2856.

A common error was to focus on the role of a sphygmomanometer in taking blood pressure instead of the role of the stethoscope. Many candidates gave imprecise answers about the nature of the 'lub-dup' sound in the cardiac cycle and it was apparent that they did not know the order of closure of the valves.

Teaching tip

These resources may aid the teaching of this topic:

<http://sprojects.mmi.mcgill.ca/mus.SHOCK/HRTSPLIT.HTM> This site has an animation showing valves opening and closing and links to the sounds S1 and S2. It clearly shows how it is the closing of the valves which causes the 'lub-dup' sounds.

<http://sprojects.mmi.mcgill.ca/mvs/mvsteth.htm> This site allows student to 'find the heart' with a virtual stethoscope.

- 5 (a) (i) This straightforward calculation was performed well by over 90% of candidates sitting the paper.
- (ii) This proved to be a difficult question for many candidates with about 50% linking the peak with the contraction of the ventricles. It appeared that candidates were not clear on the difference between events causing the ECG trace and events that occur at the same time as parts of the ECG trace.
- (iii) All candidates should be made aware that the instruction 'a tick in the correct box' means one tick in the one correct box. Rubric infringements were more common on this question than any other. Candidates should be made aware that failure to adhere to rubric instructions can result in lost marks.
- (b) This demanding question produced some good responses from the more able candidates. However, most candidates were able to obtain some of the marks. Examiners reported that box one was often filled with 'slow heart rate', which did not obtain a mark. Bradycardia is a specification term and as such, candidates should be able to recall it precisely. 'Fibrillation' was a common insufficient response for box three and again the specification term is clearly ventricular fibrillation.

- 6 (a)** Many candidates produced excellent descriptions of the membrane structure and obtained all three marks. Several candidates submitted diagrams though many failed to label them. Centres should make candidates aware that all diagrams should have appropriate labelling.

This question highlighted a continuing weakness of many candidates. When questions requiring what may be deemed to be a generic response (e.g. membrane structure or enzyme function) is set in a specific context (e.g. red blood cell structure), candidates get caught up in the context and do not provide the required generic answer.

Teaching tip

Examiners will always accept a clearly labelled diagram as a response to a question and will apply the mark scheme to such responses. Candidates should be trained to label clearly any diagram they draw in order to get them into the habit of labelling anything they submit in a written examination.

- (b)** This question was set as a low demand question and it worked well. Weaker candidates regularly failed to get all four available marks, yet there appeared to be no pattern as to which transport method they did not identify correctly.
- (c)** This question produced some well thought through responses from the stronger candidates. Weaker candidates often obtained one of the marks but rarely gave an explanation covering both 'less active transport in' combined with 'continuing diffusion out'.
- (d) (i)** As this was a June paper, the candidates sitting the paper had all studied unit 2857 and the human immune system. This question could, however, be capably answered using 2856 content. Stronger candidates were usually able to explain that the blood would contain antibodies and once that statement had been made, candidates then usually went on to pick up the second mark unless they explained the relationship between antibody and antigen as 'fighting' rather than binding to each other.
- (ii)** This was a well-answered question with the majority of the candidates obtaining both marks. Candidates occasionally did not obtain both marks due to repetition e.g. anaemia (unqualified) and sickle cell anaemia were seen as the same answer twice.

2857 Growth, Development and Disease

General Comments

This paper produced a wide range of marks and provided a very positive examination experience for the majority of candidates. Most candidates read the questions carefully and focused their answers on the questions asked. Some candidates found some of the questions difficult and this tended to be centre-related. It was pleasing to see that many candidates were able to calculate the percentage and express their answer to the nearest whole number.

Comments on Individual Questions

- 1 This question was quite discriminating. Some A grade candidates gaining all 10 marks whereas lower attaining candidates often scored 4 or 5 marks.
- (a) Most candidates were able to put the steps in the synthesis of polypeptides in the correct order.
 - (b) This part was also answered correctly by most candidates although some confused translation with transcription.
 - (c) Only high scoring candidates gained full marks for this question. They described codons and referred to the degenerate nature of the genetic code. However, many candidates were confused and stated 'the amino acids code for proteins' rather than triplets of bases code for amino acids. Some candidates wrote about the genetic code making amino acids. Many low scoring candidates gained no marks by referring to characteristics controlled by genes.

Teaching tip

Before teaching protein synthesis, have a lesson focusing on the nature of the genetic code. Ask students to read a description of the genetic code and then produce an A4 information poster describing the nature of the genetic code for a student who has missed the lesson. Ask students to include the following terms in their poster: DNA, triplet of bases, codon, amino acid, polypeptide and degenerate.

- 2 Many candidates answered this question well but some lost marks in part (c) by failing to give sufficient breadth in their description of the role of specialists in health promotion.
- (a) This was well answered by most candidates who described the trends shown by the data, used comparative figures and suggested reasons for the trends. Some candidates lost marks by failing to link smoking over a long period of time with the fact that cancer takes a long time to develop. Some candidates were confused and suggested that oestrogen protected women from lung cancer.
 - (b) Many candidates gained both mark but some lost marks by referring to mammography, thermography and ultrasound.
 - (c) Most candidates gained marks on this question but not many candidates gave an answer of sufficient breadth to gain full marks. The majority gained marks for referring to harmful effects of smoking, encouraging people to give up / not start smoking, descriptions of advice, examples of support given and the use of national campaigns to reduce smoking. High scoring candidates described the use of epidemiological data. Lower attaining candidates only referred to two or three of the possible 11 marking points.

Teaching tip

As a lesson starter or plenary, ask students to list all the possible roles of a specialist in health promotion in reducing the incidence of a named cancer. Ask students to feedback their answers and add any obvious omissions.

3 Most candidates were able to gain marks on this question.

- (a) High scoring candidates gained full marks by correctly referring to the measurement of the crown–rump length and biparietal diameter (BPD) and describing the use of ultrasound and electronic callipers. Some candidates confused the BPD with head circumference, and crown–rump length with head to toe length. A few lower attaining candidates suggested measuring the fundus of the mother or confused foetus with infant and suggested weighing the baby.

Teaching tip

Use photographs or projected images of ultrasound scans to show how these measurements are made.

- (b) A pleasing number of candidates calculated the percentage correctly and gave the answer to the nearest whole number.
- (c) Many candidates correctly identified the component of tobacco smoke as nicotine or carbon monoxide and linked it to a reduction in oxygen supplied to the foetus. Some candidates described how nicotine would constrict ‘blood vessels’ rather than arteries or arterioles, which was the required answer. A few candidates referred to carbon monoxide combining with foetal haemoglobin, which of course did not gain marks.
- (d) The majority of candidates answered this correctly.
- (e) Many candidates failed to gain this mark by just stating that more was used up. Good answers referred to there being insufficient in the diet or not taking the supplements.
- 4** A surprising number of candidates did not gain any marks on part (a).

- (a) (i) Many lower attaining candidates did not recognise the diagram as that of a virus and were unable to identify the parts. Higher attaining candidates correctly identified the capsid, reverse transcriptase and RNA.

Teaching tips

As a review of learning, provide students with unlabelled diagrams of an HIV virus and prokaryotic cell. Ask them to identify and label the structure of the virus and prokaryotic cell. Ask students to compare them, listing similarities and differences.

- (ii) Many candidates gained marks for referring to a weakened immune system and the fact that the HIV virus replicates within the body’s cells. Higher attaining candidates included correct reference to T helper cells and opportunistic infections.

- (b) (i) Most candidates gained at least two or three marks by correctly referring to intravenous drug users and the need for sterile needles and the use of condoms to prevent transmission during sexual intercourse. Some candidates lost marks by not qualifying heterosexual and homosexual with the idea of multiple partners. A surprising number of candidates were confused about the nature of HIV transmission and thought that doctors and nurses were a high risk group or old people because of their weakened immune system.
- (ii) Higher attaining candidates answered this part well by referring to mutations in the virus, changes in the antigen or protein coat, and the vaccine not being effective against different strains. A few candidates gained marks by referring to the difficulty in using attenuated HIV in a vaccine.
- (c) (i) Many candidates failed to gain this mark by not stating that the outbreak of the disease is worldwide.
- (ii) Most candidates gained both marks by referring to the lack of a vaccine and consequences of international travel.

Teaching tip

When teaching the global importance of TB and HIV infections introduce and distinguish between the terms: endemic; epidemic; and pandemic.

- 5 Part b(iii) proved to be discriminating with only the higher attaining candidates gaining 4 or 5 marks.
- (a) Most candidates were able to state that a tissue was a group of cells but fewer were able to relate this to the function.
- (b) Some candidates confused the neutrophil and lymphocyte.
- (c) Only a few candidates got both of these correct.
- (d) This question was well answered by the higher attaining candidates. They gave clear, concise accounts of: the attraction between phagocyte and bacteria / pathogen, a description of phagocytosis, reference to the formation of a phagosome and use of hydrolytic enzymes to destroy the bacteria / pathogen.

Lower attaining candidates had often incorrectly identified the cells in part (b) and went on to describe the role of B and T lymphocytes, often just picking up one or two marks by referring to 'engulfing and destroying bacteria'.

Teaching tip

Show students a silent animation of phagocytosis. Ask them to describe the process. Give them a series of pictures of different stages in phagocytosis. Ask them to put the pictures of stages in the correct order, to label the pictures with the key words and to add a caption describing what is happening at each stage.

2858/01 Case Study

General Comments

It was clear to the examiners how much preparation had been done by some centres and they deserve congratulation. In the first Case Study, it was obvious from the answers to the question on staining that many candidates had indeed carried out this technique. The ethos of this specification encourages a practical approach and many centres had clearly done a differential stain on blood smears.

Both case studies offered opportunities to discuss 'issues' – the conflict between conservation and utilisation of rain forest in Case Study 1 and the issues raised by a potential HPV vaccine in Case Study 2. Again it was clear where centres had done this with candidates being able to present arguments in a coherent, reasoned manner.

However, the examiners were disappointed in the responses to questions based on terms which were given in the Case Studies and which many candidates had clearly overlooked or not researched.

Teaching Tip

As an introduction to the Case Study, divide up the material across the group and do a KEY WORD search. Produce a GLOSSARY of these terms with short definitions. A search of the LEARNING OUTCOMES where these words appear can then be used to relate the Case Study content to the material covered on the course.

As in previous years, for many candidates it was the fundamental biological concepts which proved difficult. For example, the specification refers to organelles and their functions as illustrated by leucocytes and many candidates seemed unable to provide more generalised functions – the function of RER was often given as 'antibody production' which would be correct in plasma cells or B lymphocytes but not correct in the context of the case study where liver cells were the cells in question. Similarly, the term isotonic was explained by many candidates in terms of isotonic drinks and glucose or electrolyte concentrations rather than in terms of water potential.

A casual use of terminology led to several candidates failing to gain credit for otherwise accurate answers – elastic recoils rather than contracts, cells do not denature, enzymes do not die and oncogenes do not divide out of control. Confusion between chromosomes and chromatids and centrioles and centromeres led to inaccurate descriptions of mitosis and the lack of labelling on otherwise excellent diagrams meant that these did not bring clarification to written descriptions.

One major issue on the calculation was the confusion on the part of many candidates regarding standard form. Many candidates attempted to express their answers in standard form but frequently confused 10^3 with 10^{-3} .

Candidates appeared to have ample time in which to complete the paper with several scoring 40 marks or above.

Comments on Individual Questions

- 1 (a) The word buffer was clearly not picked up by many candidates from the pre-release material and explanations ranged from a preservative to a machine for shaking the cells (see General Comment above). Similarly many candidates offered explanations of isotonic in the context of salt or glucose concentrations rather than water potential. The examiners were happy to accept explanations in terms of osmotic balance or solute potential.
- Most candidates correctly explained denaturing in terms of a change of shape and there were some excellent references to loss of tertiary structure and breaking of relevant bonds. Weaker candidates linked the term to high temperature or pH effects without stating what actually happened to the protein.
- (b) The examiners were looking for an explanation that involved water moving in or out of the cells down a water potential gradient by osmosis. Answers which put water as part of a list or referred to the solution moving in or out were not accepted. Some candidates answered in terms of the consequence of this in terms of cells bursting or shrinking but were required to specify under which conditions this would happen before they gained credit. Again there was confusion regarding terminology – ‘if the solution is not isotonic then cells would pop due to apoptosis’.
- (c) This question required candidates to display some knowledge of the properties of water. Most attempted to describe it as a solvent but there was much confusion again over terminology with solute and solvent being confused. Many candidates referred to water being a liquid without qualifying that this is the case at body temperature. However in most cases where the property had been described, candidates could explain its relevance to the cytoplasm although some weaker candidates referred to its role in transport around the body.
- (d) Most candidates gained some marks in this question but it was not possible to gain full credit without discussing arguments for and against conservation. Some candidates attempted to answer in terms of haemotoxilin despite the fact that the Case Study states that this is not found in rain forest. The examiners were impressed by answers which suggested sustainable alternatives to deforestation and the consequences of both wide scale removal of trees and the ‘slash and burn’ approach. Some candidates seemed to be under the impression that trees are removed to harvest for drugs rather than natural compounds being identified in plants for their potential medicinal value. The destruction of rain forest so we could harvest trees for drugs and stains was lamented over by several weaker candidates.
- (e) The method for determining the width of the artery was clearly understood by most candidates but errors either of measurement or manipulating factors of 10 led to many candidates failing to gain both marks in part(i). In part (ii), some candidates failed to read the question and gave a tissue not found in the wall of arteries – bone and blood being the commonest examples. Collagen was also given incorrectly as an example of a tissue. There was confusion again as to the significance of the term ‘smooth’ when applied to smooth muscle with some candidates suggesting it had a role in preventing turbulence in the artery. However, the commonest mistakes were either to use terms such as ‘contract’ in the context of elastic tissue or imply that the smooth muscle pumps the blood along.
- (f) See the comments regarding staining in the general comments section.

- (g) Part (i) proved to be more difficult than examiners had anticipated. Clearly many candidates had encountered RER but in the specific context of plasma cells and many candidates described the role of the RER in terms of synthesis of antibodies. Other candidates referred to RER making ribosomes or making amino acids, both of which were rejected. The term 'protosynthesis' was used suggesting real confusion on the part of at least one candidate. In part (ii), only able candidates referred to the role in the infected liver cell as making viral proteins and frequently got the second mark by either reference to the protein coat or by reference to some detail of protein synthesis or viral structure. '...the RER will be used to synthesise proteins that will be used for the viral capsid' gained one candidate both marks for part (ii).
- 2 (a) Part (i) was answered well by most candidates. The most common mistake made was to confuse the role with that of lymphocytes and refer to antibody production. References to engulfing antigens were rejected. In (ii), the most common answers referred either to the presence of an infection or to protect from an infection. The Case Study referred to lactobacilli being present so references to destroying bacteria without qualification were not credited.
- (b) Part (i) of this question was not well answered. Many candidates explained that mitosis gave rise to identical cells without specifying *genetically* identical although the word 'clone' or reference to identical DNA both gained credit. However many candidates then went on simply to rephrase the stem of the question and refer to replacement of cells rather than referring to the replacement cell having to carry out the same function as the original cell. Some candidates answered in terms of why meiosis would not be appropriate and this was accepted by the examiners. However, there was confusion between fertilisation and gamete production which meant that answers involving meiosis could not always be credited.

In part (ii) of question (b), the examiners saw many excellent responses with even less able candidates scoring maximum marks. The behaviour of the chromosomes was specified in the question and it was possible to score full marks without reference to the names of the stages, although most candidates did include these in their answer. The only disappointing aspect for the examiners was the quality of the labelling on otherwise excellent diagrams. Descriptive answers can be enhanced by diagrams but without labels, it was not always possible to see if candidates meant chromosome or chromatid, or what was the cell surface membrane and what was the nuclear envelope. Weaker candidates confused DNA replication with mitosis and talked about chromosomes having two strands and replicating.

Teaching Tip

Encourage candidates to use diagrams in response to the command word 'describe' in questions BUT encourage them to produce a 'Key Words' box as a plan first and then check that structures on diagrams have been labelled at least ONCE before the word is crossed out. This works well for describing things such as cell surface membrane structure, phagocytosis etc.

- (c) Many candidates answered this in terms of the case study and the purpose of the bacteria being to strip the nuclei and this idea was rejected. The purpose of glycogen as a storage molecule was often given in responses but candidates rarely linked this to storage of glucose and the utilisation of this glucose as an energy source by the bacteria. A surprising number of candidates referred to bacteria using the glycogen and therefore weakening the person's immune response due to subsequent lack of energy. This was also rejected.

- (d)** Part (i) was well answered by most candidates although vague references to the virus being transmitted in body fluids were rejected. The examiners accepted sexual intercourse (and even 'intersexual course' from one candidate) without further qualification in terms of protection as even the use of condoms would not give 100% protection. In part (ii) explanations regarding how the virus causes cancer were well written although some candidates clearly confused the HPV virus with HIV and referred to the weakened immune system being the key factor. As pointed out in the general comments though, there is still confusion in the role of oncogenes and proto-oncogenes and suppressor genes such as P53. Proto-oncogenes are the normal regulatory genes of the cell cycle. If they mutate, they still function but no longer respond to regulatory signals. P53 is a 'tumour suppressor gene' which stops the cell cycle or triggers apoptosis if DNA is damaged. Some strains of HPV produce a protein which destroys the product of this gene so the infected cell enters the cell cycle. Part (iii) elicited some excellent responses. Candidates mainly discussed issues surrounding the testing that would be required for a new vaccine with references to possible side effects and their consequences, thus gaining the candidate two marks. Alternatively, the ethics of offering the vaccine to target groups and thereby encouraging unprotected sex or promiscuity or a rise in unwanted pregnancy or STIs was discussed. Some extremely interesting ideas were aired, such as, should the vaccine be just given to girls as they would get the cancer or should boys be given it as well as they could pass the virus on? Answers referring to the cost of development could gain credit if there were qualified with respect to some ethical issue such as re-distributing resources from other areas of health care. Answers which failed to score were mainly those which discussed vaccination programmes or tried to link the vaccine to other contentious areas such as stem cell research or confused vaccination with a screening programme for HPV.
- (e)** Part (i) proved difficult for even able candidates and several candidates incorrectly assumed that the cancer could not be diagnosed until it had penetrated other tissues, which was contrary to information given in the case study. The examiners were looking for answers which showed that candidates were aware of the potential for the cancer to 'spread' once it had access to vascular tissue - 'A diagnosis (of cancer) is only made because this would mean that the cancer is now malignant and so could spread and cause secondary tumours'. Answers that referred to the case study and implied that the cells could still revert back up to this point were also credited. Most candidates successfully scored both marks on the treatment of cervical cancer and, again, the examiners were impressed by references to electrocautery and cone biopsy, both of which were allowed, and to trachelectomy. These responses, again, indicate the time spent by some centres researching the case studies. The commonest mistakes were to use radiography rather than radiotherapy and some candidates referred to lumpectomy or even mastectomy indicating possible rote learning from earlier case studies.

2866 Energy, Control and Reproduction

General Comments

The examiners were pleased by the general standard of responses to this question paper. It is clear that many centres are emphasising to their candidates the importance of learning definitions of key words and phrases and some of the specific biological details in the extended writing answers were evidence of really thorough teaching and learning of the relevant topic areas.

There was no evidence of candidates finding it difficult to complete the paper within the allotted time.

Comments on Individual Questions

1

- (a) (i) Unfortunately this part of the question proved to be very difficult for the majority of candidates, with very few scoring both available marks.
A significant number did correctly identify the nucleus for structure **A**, but few recognised that striations or A and I bands was the required answer for structure **B**.
The examiners had anticipated that candidates would be familiar with a longitudinal section through skeletal muscle.
- (ii) Many candidates scored both marks for correctly calculating the width of the muscle fibre. Common errors included multiplying rather than dividing by the magnification figure and multiplying by an incorrect power of 10 when converting millimetres into micrometres.
Some candidates did not show their working despite the prompt to do so in the stem of the question and thus could not be awarded a mark for an answer which may have included some correct mathematics.
- (b) (i) The majority of candidates scored the mark here for suggesting that the magnification was not sufficient to see mitochondria. A significant minority incorrectly suggested that the mitochondria were inside the cells and thus could not be seen as the micrograph did not show the inside of the cells.
- (ii) Once again, many candidates scored both the marks for this part of the question, although some merely went part of the way in their explanation and stated information such as 'mitochondria produce ATP' without going on to explain why the muscle cells needed a lot of ATP.
The examiners rejected answers that stated that mitochondria made or produced energy.
- (c) Many candidates had obviously learned a detailed definition of the term *tissue* and were able to score two marks with ease.
- (d) There were some excellent answers to this question focusing upon the insoluble nature, compact shape and ease of conversion of glycogen into glucose.
Some candidates thought glycogen was a triglyceride and a common error was to state that its insolubility was an advantage as it could be transported easily in the blood stream. Relatively few candidates mentioned the large number of terminals for rapid enzyme action.
The examiners did not accept the term 'small' as an alternative wording for compact unless this was qualified by greater explanation.

- (e) Very few candidates failed to score both the marks for this part of the question and there were some really excellent answers that made mention of VO₂ max. A number of candidates referred to the benefits of using altitude training, which was awarded an AVP mark.

There was a mark available for giving an example of an aerobic exercise that could be undertaken and many candidates simply wrote 'running' or 'swimming' without qualification. It was decided to award a 'benefit of the doubt' for such answers, but teachers are encouraged to train candidates to write more specifically when describing an aerobic exercise.

- (f) The first of the extended writing answers saw most candidates collecting at least one or two marks. Most commonly these were for correctly describing why an oxygen deficit arises and for stating that lactate is produced during anaerobic respiration. Few candidates seemed to realise that the oxygen required after exercise is to enable the pyruvate (resulting from lactate conversion) to be oxidised, rather than for oxidising the lactate itself.

There were a significant number of candidates who gave a great deal of detail about the ATP-PC system in exercise without really answering the question and the examiners wondered whether these may have been candidates who were also studying PE 'A' level. The overlap between the two subjects is an obvious help at times, but only if candidates address the question that is actually being asked.

- 2 This question was generally well answered except for those parts dealing with the different types of brain scan.

- (a) (i) This was a very straightforward question and most candidates scored the available mark.

(ii) Just over half of candidates could correctly label the cerebellum on the diagram of the brain. Incorrect answers tended to label the occipital lobe region or the medulla. A few candidates did not attempt this part of the question and, as always when there is no answer line requirement, it may be that they did not realise the question was there.

(iii) Many candidates demonstrated a clear understanding of the role of the cerebellum with answers concerning posture, balance and muscular coordination. Credit was not given for the word 'affected' if not qualified eg 'balance would be affected'.

A significant minority of incorrect answers focused on disordered thinking, loss of memory and dizziness.

- (b) (i) This part of the question tended to produce disappointingly low marks for the majority of candidates. Many responses referred incorrectly to the use of either heat, colour or X-rays in MRI scans and even better quality responses tended to lack sufficient detail about the iron in haemoglobin and its effect on magnetic fields, so failing to earn full credit.

Teaching Tip

When teaching about the different types of brain scans it may be useful to get students to draw up a comparison table with column headings such as 'mode of action', 'quality / type of image produced', 'type of brain damage assessed' and so on.

- (ii) This section of the question produced similarly disappointing responses, although some candidates knew that CT scans used X-rays or that MRI scans are better for showing soft tissue damage. Many responses focused upon the relative cost of the two types of scan, which was not credited in the context of this question.
 - (c) It was evident from some of the responses that this topic had been taught with great attention to detail and with up to date information by some centres. Many candidates scored full marks and demonstrated a clear understanding of the issues involved. A common misconception was that scar tissue prevented the passage of neurotransmitters at synapses.
- 3 This question was generally well answered, although the section about Rhesus positive and negative blood groups proved difficult for some candidates.
 - (a) Many candidates easily scored the three marks here for a description of the ways in which multiple pregnancies arise. The examiners were surprised by the number of responses indicating that twins occur due to fertilisation of an egg by more than one sperm (polyspermy) and a few candidates did not read the stem of the question and went into details about IVF. Some responses continue to confuse mitosis and meiosis eg 'the fertilised egg divides by meiosis and splits to form two embryos'. The distinction between the words divide and split should also be emphasised when referring to the formation of monozygotic twins.
 - (b)
 - (i) This question was very well answered although a few candidates were confused as to the difference between *antigens* and *antibodies*.
 - (ii) A significant number of candidates failed to appreciate the significance of the second Rhesus positive pregnancy in a Rhesus negative mother and thus did not score highly on this question. A number also referred to the maternal and foetal bloods mixing across the placenta. The examiners rejected references to the maternal and foetal bloods 'clotting'.
 - (iii) This question was targeted at the very able candidates and as such it proved to be a good discriminator. Most candidates explained the treatment offered rather than describing it and a number suggested 'blood transfusions'.
 - (c) Where candidates used the graph provided as instructed, high marks were achieved. Unfortunately a significant number of candidates appeared to write everything they knew about hormones in pregnancy rather than referring specifically to those shown on Fig. 3.1. The Quality of Written Communication mark was awarded to the majority of candidates.
- 4 This question tended to be the least well answered on the paper. It would appear that the biochemistry aspects of the specification remain very challenging ones for a large percentage of candidates.
 - (a) Many candidates simply described the structure of ATP in their response to this question. Better answers focused upon the different sugars in the two nucleotides or the fact that DNA nucleotides had four different bases whereas ATP only had one. A significant number of candidates referred to the structure of DNA rather than a nucleotide from a DNA molecule as demanded by the question and wrote responses such as 'DNA is a double helix and ATP is a single strand'.

- (b) (i) A surprising number of candidates did not score a mark for this part of the question. Many responses referred to the cells 'exploding' or 'shrivelling up as all the water inside them would evaporate out'.
What was required was an explanation of enzymes / proteins in the cell denaturing due to a change in the shape of their active site, or reference to enzymes no longer being able to work at their optimum temperature.
A significant number of candidates wrote that the 'cell denatures', which was not credited.
- (ii) This part of the question was targeted at the more able candidates and few responses scored the two available marks. The examiners were pleased by the number of responses that referred to the idea of energy release being controlled as only one phosphate group is released from ATP at a time. Few candidates mentioned the idea of energy being transferred to other molecules from ATP rather than being released as heat.
- (c) (i) Some candidates could recall the events occurring in prophase 1 accurately and made mention of the chromosomes condensing, the formation of the spindle fibres and the pairing up of homologous chromosomes to facilitate crossing over.
A large number of candidates' responses referred to chromatids lining up and there were frequent contradictions between the information candidates gave in their written responses and the diagrams drawn below.
Many diagrams were unlabelled.
- (ii) A relatively few candidates scored both marks for correctly identifying the uses of ATP in meiosis. The examiners had anticipated that DNA replication and protein synthesis would be stated by the majority of candidates, but in fact these responses were rarely seen.
Many candidates did not appear to realise that cytokinesis is part of cell division, but not part of meiosis. A significant number of responses identified that energy would be needed to 'pull the chromosomes apart during anaphase', but without further qualification concerning the role of the spindle fibres in this process.

5 Most candidates appeared to find this an accessible question.

- (a) (i) A large proportion of candidates correctly calculated the predicted shortfall in grain production using the graph. A few of these lost one mark for using incomplete units in their answer.
The most common error was for candidates to calculate the shortfall for 2020 rather than for 2010. A significant minority attempted to turn their answer into a percentage.
- (ii) This was well answered by most candidates and full marks were awarded in the majority of cases.
- (b) (i) Many candidates appear confused by the difference between the terms accurate, reliable and fair and thus use them inappropriately. In the context of this question, an average could be calculated if the experiment were performed over several years, which makes the data more reliable. Accuracy is concerned with the measuring equipment used to generate the results, and fairness with the control of variables – which may have been relevant in this case if factors such as different weather conditions in different years were referred to.

- (ii) Once again, many candidates collected two marks for identifying the conclusions correctly. A few responses lost marks for using phrases such as 'manure is a good fertiliser', without further qualification.
- (iii) Some candidates had obviously learned a definition of the term sustainable and earned a mark for the idea of the fertiliser being suitable for use over a prolonged period of time (or the reverse argument).
Fewer candidates went on to relate the idea of sustainability in this context in being successful in producing the resource being harvested. Many candidates made reference to harmful effects of inorganic fertilisers such as eutrophication, but the question was about the sustainability of use on arable land, so specific reference made to damaging soil structure was required in order for a mark to be awarded in this context.

6 There were a number of easy marks available in this question and most candidates accessed these without difficulty. The final section of the question was aimed at the most able candidates and this indeed proved to be challenging for the majority of candidates.

- (a) (i) Most responses focused upon the fact that phagocytes 'engulf' bacteria, but then failed to continue with the description of what happens after that. A few candidates made the, perhaps predictable, mistake of stating that phagocytes produce antibodies. A pleasing number of responses made reference to the role of macrophages as APCs.
- (ii) The majority of responses suggested the use of antibiotics, although a significant number stated 'eyedrops' with no further qualification. The examiners accepted 'anti-inflammatories' or 'antiseptics' as alternative responses.
A small but worrying number of candidates thought a suitable treatment for conjunctivitis was the 'surgical removal of the eye'.
- (b) (i) This part of the question was disappointingly answered by the majority of candidates. Few realised that the majority of refraction is performed by the cornea, with the lens making fine adjustments. Most responses ignored the role of the cornea altogether

Teaching Tip

Students often fail to answer question set on topics that they covered at GCSE. Ensure students have to demonstrate current knowledge of topics that should already be familiar to them.

- (ii) Very few candidates failed to score the mark here for identifying refraction as the correct term for the bending of light rays by the eye.
- (c) (i) Once again, the vast majority of candidates scored the mark here for identifying the rods and cone cells. A few candidates lost marks because they only named one of the two types of receptor.
- (ii) Few candidates scored marks here, but this part of the question was aimed at the very able candidates. It was pleasing to note the number of sensible, if not credit-worthy responses produced by the less able candidates.

2867 Genetics, Homeostasis and Ageing

General Comments

There were fewer blank spaces on the paper this year, which made it possible to credit positive achievement more effectively. However, a worrying number of candidates had handwriting which was very difficult to read.

It was pleasing to see that even where candidates were struggling, there was good evidence of knowledge and understanding which indicated an interest in the subject. The Examiners were confident that candidates were able to demonstrate some positive achievement.

Any science paper will involve dealing with data. Clear understanding of the difference between the words 'describe' and 'explain' continue to be a problem for many candidates, as are the calculations.

60 marks on this paper are available for synoptic questions. These questions include over-reaching skills such as calculations, as well as questions using facts, principles and concepts from Modules 2856, 2857 and 2866. Candidates are expected to apply these facts in the context of the content for Module 2867. The topics included in this module are themselves 'over-reaching' and cannot be adequately understood without using material learnt in previous modules. However, candidates frequently fail to 'spot' the questions which require synoptic knowledge, or to be adequately familiar with the relevant synoptic topic.

Teaching tip

Candidates have difficulty in spotting the synoptic links. When a topic in the 2867 specification is first being discussed or during revision, candidates could create mind maps around a central topic e.g. genetics in 2867 associates with DNA, genetic code, protein synthesis etc in other modules.

Comments on Individual Questions

- 1 Generally candidates scored well on this opening question.
 - (a)
 - (i) The majority were awarded this mark. Only a few candidates lost a mark by not using units.
 - (ii) Many candidates scored 2 marks for this question - the first part most often scored correctly. The most frequent answer for the second part was receptors on/in the skin and there were very few references to the autonomic/sympathetic/ parasympathetic nervous system.
 - (iii) This was generally a high scoring part of the question with many candidates scoring 5 or 6 marks. The most common reason for not achieving high marks was for not explaining how the mechanism was related to either increasing or decreasing body temperature and just referring to a change in temperature. A large number of candidates also described how metabolic rate can be increased by thyroxine in some detail, rather than giving an overview.
 - (b)
 - (i) The majority of candidates scored 2 marks for the calculation and followed the instructions to record the answer to 2 decimal places.

- (ii) This was the lowest scoring part of the question. A lot of candidates referred to surface area, but not surface area to volume ratio, so failed to score the 2 marks available. There were references to the differences in body shape, but often a comparison was not made between the 2 individuals. Only a few candidates referred to natural selection.
- 2 Most parts of this question were answered well, and scored highly, though (c) (ii) was answered poorly and showed a lack of understanding of the role of saturated fat in development of heart disease. 5.1.2.4(c) Some candidates also had great difficulty in describing the data presented in the graph in (d).
- (a) Most candidates correctly understood the role of beta cells in supplying insulin and the fact that they would be attacked and destroyed by the host antibodies. Fewer candidates recognised this as autoimmunity or that it might lead to hyperglycaemia. No credit was given for using the term diabetes alone. Examiners were looking for a correct reference to diabetes mellitus or Type 1 / insulin dependent diabetes.
- (b) (i) Many candidates correctly linked the time delay in blood glucose concentrations returning to normal to a reason why insulin takes time to act, eg slow release from cells, time for liver to absorb glucose, etc., for one mark. However very few gained a second mark for linking this to homeostasis or the fact that this leads to fluctuating levels of blood glucose around a set point.
- (ii) Many candidates correctly stated that the blood sugar levels rise and stay high and linked this to diabetes, for two marks. There were some good descriptions of Type 2 diabetes. Very few candidates explained why glucose levels rose or why they began to fall after 90 minutes. Examiners were looking for some reference to glucose not being absorbed by the cells or converted to glycogen for storage, or that the levels fell due to its use in respiration, or its excretion in urine.
- (c) (i) Few candidates scored well on this question, with many showing a lack of understanding of the differences in structure between refined sugars and starch. Examiners were expecting candidates to state that refined sugars are easily digested and quickly absorbed leading to a surge in blood glucose levels, whilst starch is a complex carbohydrate/polysaccharide, which is broken down to glucose and released more slowly. A common error was to see candidates talking about the quick and slow release of energy rather than sugar.
- (ii) This question was synoptic and was poorly answered by most candidates. Many candidates thought that fat was converted into sugar and that this had an effect on the blood sugar levels, rather than the excess sugar in diabetics being converted and stored as fat (lipogenesis). Better candidates correctly understood that saturated fat would raise blood cholesterol levels, leading to an increased risk of CHD or atherosclerosis, but very few described the process of atherosclerosis correctly for the third mark. Examiners were looking for some reference to cholesterol being deposited in the coronary artery wall leading to a narrowing of the lumen.

Teaching tip

As candidates have difficulty in spotting the synoptic links, it would be useful to revise starch/glycogen and glucose structure and CHD/atherosclerosis when discussing homeostasis of blood glucose.

- (d) Weaker candidates struggled to understand the graph Fig. 2.1, and made statements such as 'statins only had a negative effect on cholesterol levels but a positive effect on insulin resistance' or discussed changes in levels, which gained no credit. However most candidates scored well, correctly identifying the lowering of LDL levels in all groups, the increased insulin concentration/resistance in the statin group and the decreased insulin concentration/resistance in the diet only group. Few candidates spotted the cumulative effect on LDL concentration, or stated that LDL was lowered most by diet and statin combined.

Teaching tip

As part of the revision process, candidates should be given ample opportunity to analyse data presented in tables and graphs of a variety of types. Examples can be obtained from Biology and Human Biology past papers.

- 3 Examiners were pleased to note that candidates throughout the ability range were able to score some marks on the QWC question (a).
- (a) While few candidates scored all seven marks here, there were a number of scripts scoring 3-5 marks, making good points, but not using the specialist terms. Some examples include the use of brain cells, not neurones, and hairs, not hair cells, in the cochlea. Good answers gave extra detail in relation to degenerative disease by including mention of plaques, tangles, etc. With reference to changes in hearing, a few candidates noted loss of hearing low pitch sounds not high pitched sounds. Good answers made reference to fragment accumulation (only the best connected this correctly to lysosomes), break down of pigments, rhodopsin and iodopsin, and/or, hair cells, the cochlea and the auditory nerve. Weak candidates usually gained the odd mark or two in terms of cataracts or at least clouding of lens. Non-scoring points made by candidates referred to presbyopia and to changes to the skeletal system eg arthritis, thereby not addressing the question.
- (b) (i) The most common answers referred to cognitive/small tests in name and / or detail. Not many described a test as cognitive and also included a description. Tests covered showing and removing objects, remembering names of relatives and recalling stories. Some wanted to look at the mechanics of the person finding their way round their house, doing every day things. Quite a few suggested CAT/MRI or PET, but very few gave sufficient extra detail to gain more than one mark. For CAT, answers occasionally included a 3-D image and the use of X-rays. MRI answers generally referred vaguely to magnetic fields, but not with sufficient detail to gain a mark. Often candidates wrote about cognitive/practical tests and an imaging technique, often just gaining one mark.
- (ii) Most candidates gained at least one mark, most often referring (one way or the other) to the burden of care falling on the daughter. Other answers also included the degenerative nature of dementia, and changes in behaviour and recognition of others (daughter). Many also referred to giving up work, financial burden (some referred to taking on his finances as a burden, others acknowledged that looking after him may have a financial cost for her) or putting him in a home.

- (iii) The most common mark scoring point referred to care at home. Many mentioned visits to a GP, financial help and consultation of other organisations. One or two candidates wanted the social worker to actually physically look after the man (there was some doubt at times about who does what). Some answers strayed into treatments. Some only scored one mark by giving the same answers twice with a different emphasis.

4 Generally this question scored well and students had good knowledge of transplantation issues and aftercare, less sound was their understanding of tissue typing.

- (a) Practical issues: the most common responses were shortage of organs, tissue matching/typing and rejection. It was good to note that some candidates emphasised that you cannot use a living donor and that the heart must be the correct size. Ethical issues: most common responses were the pressure on relatives to donate, religious objection and the use of xenotransplants or selling organs. Quite a few candidates discussed the possible objection if the recipient had 'self-inflicted' heart disease, but only a very few candidates discussed the cost compared to a larger number of cheaper operations.

The award of the QWC mark was not generally a problem - 98% of candidates got this mark. The spelling of some basic scientific terms such as "donar" and "recipient" still remains a problem for some candidates, as illustrated.

- (b) This part was well answered by many candidates who scored full marks. The most frequent answers were a healthy diet, avoiding saturated fat/cholesterol, salt and smoking, but very few responded with 'maintaining a normal weight, which is surprising with obesity very much in the news at present. Hardly anyone talked about anti rejection drugs and those that did, confused these with antibiotics and did not emphasise that they were a life-long measure.
- (c) This part of the question caused problems for most of the candidates. There were some excellent answers where the candidates knew this topic really well, but a significant number knew nothing about this topic. There was some confusion over gene loci and genes. Very few candidates referred to antigens in the cell membranes except in red blood cells.

5 This question was based on a challenging genetic cross and was also linked with the χ^2 test. This test is specified in the Mathematical Requirements on Page 89 of the specification. The table was presented so that regardless of whether the candidate could remember how to work out degrees of freedom for χ^2 , the answer was always the same. All A2 candidates should have an understanding of what probability means and therefore be able to interpret a probability table such as this one. A large number of candidates were not able to present the alleles correctly, some candidates did not realise that they needed 2 alleles for each of the 2 characteristics.

- (a) Many candidates stated that the characteristics would be inherited together, but then didn't suggest how the presence of one could indicate the presence of the other.
- (b) Most candidates identified the long index finger as a recessive allele, but a lot then failed to clearly explain the reason.
- (c) (i) Many candidates scored full marks here.
(ii) Many candidates scored full marks here, but a significant number presented a list of all four possible combinations of alleles.

- (d) (i) Very few candidates could interpret this table; a large number knew that 0.05 was a key probability value.
- (ii) Very few candidates could use the data to conclude here, although a significant number stated that there was a very low probability.
- (iii) Many candidates could give the parental genotypes and gametes and draw a Punnett square from these. However, only a very few candidates could identify that certain phenotypes in the offspring were recombinants, but a larger number stated that this was a result of crossing over/chiasma formation.

6 Overall, this was not a well-answered question, with an average score of about 6 marks.

- (a) (i) This was generally well answered with most candidates recognising the need for nutrients and/or hormones for growth/differentiation/division. A number referred to temperature but rarely specified 37⁰C or body temp. Only an occasional reference to pH was seen and very few mentioned the need for a sterile medium.
- (ii) A large number gave a correct response, with bone marrow being the most frequent answer. However, a sizeable minority ignored the bold type and just stated stem cells.
- (iii) Many answers quoted the increased risk of mutations and/or Down's syndrome, while some referred generally to an increased risk of disease or illness without specifying a genetic cause. Only a few references to cancerous cells were seen.
- (b) (i) Most answers referred to oestrogen production but many missed the 2nd marking point often referring to periods rather than the menstrual cycle or menstruation.
- (ii) This was the highest scoring part of the question. Most candidates gave advantages as being reduced risk of osteoporosis and relief of symptoms such as hot flushes or mood swings or vaginal dryness. Very few mentioned decreased risk of heart disease (CHD). Almost all answers referred to fertility and the ability to have children late in life after a career. This was seen as a great advantage by many. For disadvantages, many recognised the increased physical demands of pregnancy and childbirth for older mothers and the higher rate of foetal abnormality (Down's syndrome often quoted). There were very few references to selection/division of cells/hormone production or increased risk of breast cancer. A few thought it grossly unfair that young children would have to look after their aged parents.
- (c) Almost all candidates referred to HRT and went on to give further detail about patches and cyclic regimes etc. A relatively small number referred to phytoestrogens or antioxidants. References to sources of phytoestrogens were very rare. There were even fewer references to isoflavones/coumestans/lignans or vitamins.
- (d) This was the poorest answered section. There were hardly any references to defective female gametes increasing the frequency of alleles that cause disease, but many references to screening of gametes for disease or discarding or not implanting embryos with diseased alleles. A few answers referred to embryo screening leading to selection for healthy babies. The possibility of damage to DNA was not considered. There were too many unqualified references to eggs and alleles.

- 7 Candidates found this question difficult and it was generally not well answered.
- (a) (i) Very few students achieved any marks for this part of the question. Marks that were gained came from a description of the symptoms of Turner's syndrome rather than the generic description of a syndrome.
 - (ii) The majority of candidates were able to gain at least 2 out of the 4 marks for this part of the question and there were some very good answers. Many correctly identified that this was due to non-disjunction, although some did not use the term, but offered a description of what happens to the chromosomes. Some candidates did not specify sex chromosomes however and some mistakenly confused Turner's with Klinefelter's syndrome.
- (b) (i) Very few candidates were able to describe this procedure. However, 1 mark was awarded to many candidates who were aware that a 'karyotype' was the end result.

Teaching tip

This question required AS knowledge and candidates should be encouraged to revise procedures like karyotyping and others from the AS specification for this synoptic paper.

Those candidates who received full marks for this question generally had a good grasp of the procedure.

- (ii) Some candidates correctly identified that chromosome mutations involved change in shape or number of chromosomes, for 1 mark, but very few were able to convert this to 2 marks with extra information.
- (c) The majority of candidates scores 1 or 2 marks for this part of the question. Many chose the issues surrounding abortion to discuss. 'Designer babies' were mentioned by a large number of candidates, which did not gain credit as the jargon term was used without adequate explanation.

2585/02 Investigate Skills and 2868 Extended Investigation in Human Biology

Continuing the trend since the specification went live, the number of candidates that entered at both AS and A2 showed a significant increase. The number of centres increased by 25% at AS and 33% at A2.

Evidence of substantial work and effort by the teachers was clear in many centres, with many candidates being trained well in the four/seven skill areas to be assessed. The written work submitted reflected a wide range of ability which was in general marked internally at an appropriate level. The range of investigations undertaken at AS level followed the same pattern as previous years: osmosis, membranes and enzymes. At A2, it was pleasing to see more centres undertaking human physiology investigations with able candidates.

General summary

At AS, with experienced centres there was clear evidence that advice given in reports had been heeded and followed. Centres which were new to the specification showed variation in the understanding of the hierarchical descriptors. At A2, there was concern that some centres misunderstood the requirements of the 3 additional skills which resulted in some marks being adjusted.

Centres are asked to ensure that marks submitted on the MS1 sheets are the final total marks (out of 60/90) rather than the initial candidate totals. It would also aid the moderation process if work could be sent in accessible packages – there is no need for work to be sent in plastic wallets or A4 folders; indeed this hinders the moderation process and incurs unnecessary postage costs to centres. Providing all work is suitably collated and stapled then work can be sent with the CCS160 cover sheet attached.

In accordance with the requirements of the specification it is important that centres provide evidence for the 'a' strand descriptors in the I skill to support the marks awarded. This can be in the form of a tick list or annotations on individuals' scripts.

Again centres that were adjusted fell into 3 main categories ie centres that had:

- chosen an inappropriate task
- misapplied the hierarchical mark scheme
- erratic marking within the centre

with the first and last categories being the most common.

Concern still exists that the subtleties of the generic mark scheme are inadvertently overlooked in some Centres which impacts on the marks such as P5ai and P7aii or E3a and E5ai. At A2, the main areas of discrepancy arose in the following areas:

- S skill: with several candidates, and on occasion's whole centres, failing to submit a separate report.
- R skill: with candidates failing to suggest improvements and supplementary questions.
- P skill: insufficient use of scientific knowledge and understanding (SK&U) at an A2 standard.

Any centres who wish to gain more detailed feedback regarding this year's moderation, or proposals for next year, via the coursework consultancy service, available free of charge, via the Subject Officer.

Administration

On the whole Centres submitted the correct forms completed in an appropriate manner. It is important to note that the 3 additional skills at A2 should be recorded on the 'Additional Skills' form for each candidate and submitted with the work.

Centres are encouraged to note that a 'Centre Authentication Form' must be submitted for **both** AS and A2 entries. Failure to do so will mean that this has to be requested at a later date and could potentially delay the publication of candidates' results.

Most forms that will be required for any particular session can be found on the website:

http://www.ocr.org.uk/qualifications/publications/AS_ALevelGCEHumanBiology.html

Annotation, in the main, was clear and accurate. It is preferable that teachers annotate in the style of:

- | | |
|---------|---|
| P5ai ✓ | to indicate a full match |
| I5bii x | to indicate the sub descriptor is not met |
| (E5bi) | to indicate a partial match |

Tolerance

AS: A tolerance limit of plus or minus **four** marks (out of 60) is applied to the AS investigative skills.

A2: A tolerance limit of plus or minus **six** marks (out of 90) is applied to the A2 extended investigation.

Hierarchical nature of the mark scheme

A common error for new centres was the failure to award intermediate marks correctly. For each skill, the scheme allows the award of intermediary marks - 2, 4 and 6 - that are between the defined mark levels. An intermediate mark may be awarded when a candidate meets **all** the descriptors for one level e.g. level 3 in planning **and** also meets **50%** of the sub descriptors for the next level e.g.

- i) **all** of P5a (ie P5ai, P5aii and P5aiii) **or**
- ii) **all** of P5b (ie P5bi and P5bii) **or**
- iii) 50% of the P5a and P5b eg P5ai, P5aiii and P5bii.

The award of 8 marks for the P and A skill has caused some difficulties for some Centres again this session. It is **not** necessary for a candidate to go beyond the specification to gain 8 marks. Also candidates who write excessively in an attempt to score 8 are unlikely to be awarded P7aii due to irrelevance or A7bi on the grounds of failing to be concise.

Nature of tasks

Common tasks included enzyme investigations e.g. the effect of temperature, enzyme concentration, substrate concentration and pH, membrane permeability with temperature and alcohol and osmosis. These investigations were suitable for all four skills and allowed access to the higher descriptors.

Centres are advised to note that whilst individual investigations, especially at A2, are educationally invaluable they can lead to inconsistencies in the marking and moderating process. This can lead to centres falling out of tolerance due to one /two specific investigations and hence the whole cohort being adjusted as a consequence. In these cases it is likely that additional scripts will be requested from the centre or work returned to the centre for a remark to prevent such an adjustment from occurring. Centres are reminded there is no requirement for each candidate to carry out a different investigation. Centres should also ensure that any

investigation undertaken by human subjects conforms to the advice given by CLEAPSS eg use of caffeine/alcohol (<http://www.cleapss.org.uk>).

a) Human Physiology investigations:

The main area of concern and cause for adjustment this session was due to the failure to meet 3 key sub descriptors. The details given below are meant as amplification of the sub descriptors and are in no way an alteration to the specification.

P3aii In the case of Human physiology investigations it is paramount that the candidates recognise the vast range of factors which should be **considered** when dealing with Human subjects. This should include key factors such as age, gender, BMI, culture, smoker/non-smoker and 'fitness levels.

P3b For P3b candidates should plan **at least 10 subjects** in each of five categories, as this is good practice.

It is realised that this is not always possible to **implement** and so data must then be collected from a minimum of **ten subjects** in a minimum of **two** categories. It is recommended that these issues are made clear to the moderator in a letter accompanying the work.

P5bi Candidates are required to give a detailed description of the strategy, including apparatus and variables, which allows it to be repeated by another student. Candidates should be encouraged to ask 'can this be followed by another student?' The strategy should enable data to be collected to the same degree of precision and reliability. Details such as 'take the blood sample and record the result' are insufficient when using apparatus such as 'Accu-check'®.

b) Secondary data investigations:

Very few SDI were seen this session. It appeared that weaker students had chosen to attempt these investigations and in most cases found it hard to score the medium/higher descriptors due to the challenges which are inherent in this type of investigation (see 'Principal Moderator's report to Centres, June 2005').

c) Predictions

At both AS and A2 it is imperative that the predictions made by the candidates are justified using scientific knowledge and understanding at an appropriate level. Hence for AS, it is required that candidates' state what they predict but also explain using theory from the AS specification to say **why** they think this. This theory should be directly linked to the prediction and integrated with the prediction, not presented under another side heading. The same is true for A2 which requires the prediction to be justified to an A2 standard and with A2 SK&U. Failure to do this in either case will limit the P skill mark to a maximum of 4 in either unit.

d) Inappropriate tasks for A2:

It is imperative that the investigation is **centred** on a topic from the A2 specification. For example an investigation which looks at the effect of pulse rate before and after exercise can easily permit candidates to base their prediction and analysis on the method used to measure pulse rate and the scientific knowledge and understanding (SK&U) related to pulse rate, without the emphasis being placed on the SK&U taken from the A2 specification ie exercise. Investigations based purely on enzymes such as 'decay in tissue' are also open to pitfalls in both the P and A skills as the work is not centred on an A2 area.

It is strongly advised that Centres submit proposals to the Subject Officer for comment through the free coursework consultancy service to ensure the topic and emphasis of any investigation is appropriate.

e) Ethical issues and safety concerns:

There were several areas this session where moderators have been concerned with the safety aspects and ethical issues of some investigations. For example, some candidates asked preliminary questions which then informed them that heating daphnia to temperatures higher than 40°C will kill them. They then went on to heat Daphnia to temperatures much higher than this and hence this can be regarded as not taking into account safety and ethics. This will prevent the supporting of I1a in the I skill and could also affect the P skill (at P5aiii). Another area of concern included candidates heating large volumes of methane which obviously has serious safety implications. The administering of caffeine and/or alcohol to students or other adult subjects must always be in accordance with the advice given by CLEAPSS. There were also centres that implied they had collected data on smoking from students who were below the legal age limit for smoking, again this cannot be condoned.

Centres should remember that the safety of all subjects involved in any investigation remains the responsibility of the teacher/centre and not OCR. Teachers should ensure that they follow all necessary advice from appropriate bodies and consider carefully investigations that they authorise.

Implementing skill:

In several cases, candidates' marks were adjusted due to the use of 'split tables'. All **raw data** should be displayed in a **single table** to allow a comparison to be made of the independent variable range and the replicates. The independent variable should be in the first column with SI units for both the dependent and independent variable in the appropriate row/column heading(s). Failure to do so will limit the mark to 4 for this skill. On some occasions it was evident that Centres had provided blank tables to their candidates which encouraged students to submit the data in split tables, thus limiting their marks to a maximum of 4.

Analysis:

Failure to show evidence of simple processing of data such as calculating an average will result in the A skill mark being reduced to zero as A1a will not be met.

A3a is the presentation of the processed data e.g. a histogram or bar chart used in the correct context (bar charts to represent discrete data and histograms to represent continuous data). Whilst the use of ICT is to be encouraged candidates should ensure they could use the packages at a suitable standard to produce a graph of suitable quality. There should be sufficient horizontal and vertical grid lines to allow new intermediate data to be extracted accurately. In several cases graphs produced using software packages such as Microsoft Excel® did not fulfil this criteria. All graphs should also have an informative title, axis labels, appropriate units on both axis and an appropriate line drawn. Some examples of suitable and unsuitable graphs are provided in the 'Principal Moderator's report to Centres, 2005'.

The use of range and error bars can provide evidence for certain descriptors but in many cases this was confused:

- range bars – consists of plotting the highest and lowest value of data above and below the average. As this requires no mathematical processing it can not be used for A5a but may be discussed in detail to help provide evidence for E5bi.
- error bars – consist of calculating the standard deviation of the data and plotting a bar from the mean \pm 1 SD. The calculation of the SD can be used to credit A5a, and again the discussion of the error bars can be used to provide evidence for E5bi. Centres should note that the SD can be determined for assessment purposes even if there are only 3 sets of data as it is the skill that is being assessed not the numerical answer.

As with the prediction in the P skill, A5bi requires conclusions to be **linked** with **detailed** scientific knowledge and understanding of an **AS** (or **A2** as appropriate) **standard** and linked coherently, comprehensively yet concisely for **A7bi**.

Evaluation

The use of suggested writing frames was encouraging this session and it appeared that this had indeed helped the weaker candidates score more highly in this skill.

There remains confusion in some Centres as to the difference between errors and limitations:

- **A limitation** – is a fault that lies within the method and will potentially affect each trial/run of the method such as the fluctuation of the temperature in a waterbath or the parallax error when reading a meniscus.
- **An error** – is a fault that occurs at random and effects intermittent set of data/one point such as the failure to measure out a chemical correctly for one run.

Candidates should provide suggestions for any anomalous results found. These should be separate reasons from those used to support E3a. A limitation in the procedure will potentially affect every result and hence is not usually the cause of an anomalous result. Such results are usually caused by an error not a limitation.

For E5ai the candidates must provide evidence that they have assessed the different errors/limitations and decided **for themselves** which is/are likely to have the largest effect(s). On several occasions this was seen to have been decided by the teacher marking the work and not the candidate. Hence this was not supported by the moderator and marks were limited to 4.

Searching for information

This skill is a separate section to the P skill and as such should have a separate report of 500-1000 words. The material that is extracted should be quoted in the report and it should come from a mixture of both written and digital sources. Failure to do any aspect of this will result in a mark of zero.

To gain S5a candidates should **explain** their choice of diagrams, charts, data etc selected from the sources listed in terms of the usefulness to the investigation and validity of the information presented in the source, and finally for S5b the report produced should **coherently integrate** the information gained from the sources with evidence of a variety of presentational techniques such as tables, graphs and pictures.

Recording an interview

In some cases candidates only recorded 8 questions, or 6 questions then 4 supplementary questions etc. In both these cases as an initial 10 questions had not been recorded R1b could not be supported and the mark for this skill was limited to zero. This year saw more interviews and questions asked on topics unrelated to the planning and/or analysing of the data and hence this also limited the mark in this skill.

A common misinterpretation of R3b was the failure to recognise the two aspects to the descriptor: suggesting supplementary questions **and** suggesting improvements to the interview. It is essential that the candidate highlights the questions which are supplementary and not left to the teacher/moderator's interpretation. Equally, supplementary questions should be thought of during or after the interview not planned in advance of the interview.

To gain R5b these supplementary questions must be **asked** and evaluated in terms of the investigation.

Suggested writing frames/tables

These tables can be used to guide the candidates, without unfair assistance, in the fulfilling of various sub descriptors. Depending on the depth and detail of the content within the table the sub descriptor(s) may be partially or full met. A variety of these can be found in the 'Principal Moderators report to centres, June 2006'

Centres and teachers new to the OCR specification, or starting the A2 course for the first time are strongly advised to attend a Human Biology specific INSET meeting during 2007-2008. Details are available on the OCR web site. Centres are reminded that there is a Coursework Consultancy service that is provided without cost. Details are available on request from the Subject Officer (david.scott@ocr.org.uk).

**Advanced GCE Human Biology (3886 / 7886)
June 2007 Assessment Series**

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u	entry
2856	Raw	60	40	35	30	25	20	0	1512
	UMS	90	72	63	54	45	36	0	
2857	Raw	60	45	39	33	28	23	0	2115
	UMS	90	72	63	54	45	36	0	
2858A	Raw	120	91	79	67	55	43	0	2049
	UMS	120	96	84	72	60	48	0	
2858B	Raw	120	91	79	67	55	43	0	81
	UMS	120	96	84	72	60	48	0	
2866	Raw	90	66	57	48	40	32	0	561
	UMS	90	72	63	54	45	36	0	
2867	Raw	120	81	71	62	53	44	0	828
	UMS	120	96	84	72	60	48	0	
2868	Raw	90	72	64	56	48	40	0	824
	UMS	90	72	63	54	45	36	0	

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3886	300	240	210	180	150	120	0
7886	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
3886	3.8	15.0	34.2	59.0	83.6	100.0	1756
7886	6.0	22.1	46.6	74.7	95.2	100.0	828

3886 - 1756 candidates aggregated this series

7886 - 828 candidates aggregated this series

For a description of how UMS marks are calculated see;
http://www.ocr.org.uk/exam_system/understand_ums.html

Statistics are correct at the time of publication

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