

Biology

Advanced GCE A2 7881

Advanced Subsidiary GCE AS 3881

Report on the Units

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Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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Chief Examiner's Report

This session represented the overlap period between the new AS and legacy AS specifications. As far as the legacy specification was concerned, it was pleasing to note a good range of responses with no evidence of a decline in standards. The entries for 2802/01 and the various components of 2803 were very similar to previous January sessions, but the entry for 2801/01 was reduced to a largely retake cohort in line with the other AS units. The overall outcome for 2801/01 matched the other units. There was no evidence that the candidates were short of time at either AS or A2. The A2 entries were very similar to previous January entries at this level.

Calculation questions designed to test the candidates' mathematical skills have been set over the lifetime of this specification. Candidates do not find these easy. There was a welcome improvement noted last summer, but this session showed up the perennial problem some candidates have with ideas such as percentage increase.

Another recurring problem is the way in which candidates apply previous mark schemes to the current question. Use of previous questions and mark schemes is clearly an important teaching and revision tool, but candidates must be encouraged to read the paper they are actually answering carefully and then answer the question set. Examples of this occurred at A2 in the question on Zoos in 2805/03 and muscle structure in 2805/05 where the slant in the questions was slightly different to previous ones on these topics.

We can only reiterate again the importance of using the command words and the mark allocation to provide information on the type of answer required and the depth to which it should be answered. If a question asks for both description **and** explanation, candidates should expect to be rewarded for demonstrating **both** skills. An example of this occurred in 2803/01 in question 1, where both a description and explanation of the effect of wind and temperature increase on water uptake by a potometer were asked for.

The Chief Examiner received fewer comments about illegibility which perhaps indicates that candidates are responding to centres' advice in this area.

The coursework and practical exams at both AS and A2 went smoothly and many candidates showed a good grasp of much of what was needed. The problems with late or poorly annotated coursework, which was commented on last summer, were not noted this session which was encouraging.

Overall, there was evidence of good biology on display, indicating that many candidates had been well prepared and had worked hard to understand basic principles and processes. Centres should continue to stress the importance of using biological terms in their correct context and expressing ideas in a logical sequence. Teaching strategies should include the application of biological principles to unfamiliar material.

2801 Biology Foundation

Comments on individual questions:

Question 1

- (a) This was not well answered by a significant proportion of candidates. Those who had some idea of how to perform the calculation experienced problems in converting between units (i.e. cm or mm to micrometres), resulting in answers that were out by a factor of 10 or 100. Although candidates were directed to use the scale bar, some strange figures that did not relate to the dimensions of the scale bar were used in many cases.
- (b) This part of the question discriminated quite well. Candidates were asked to use the term 'water potential', so answers including concentration of water or numbers of water molecules were not credited. Some candidates demonstrated confusion by incorrectly defining high or low water potential but most were able to state that water would enter the cell, although not all linked this to osmosis. Candidates were expected to refer to the cell rather than to the leaf, and a significant number of candidates were not awarded the mark that required this distinction. Although marks were available for stating that the cell contents would increase in size, they would press against the cell wall, an increase in the cell's water potential until equilibrium and the role of the cell wall in preventing bursting, these marks were less frequently accessed.
- (c) Many candidates correctly identified structure A as a chloroplast. A significant number suggested mitochondria, even though these organelles cannot be seen at this magnification. Candidates who read (ii) carefully were able to suggest an appropriate function. As the question had specified the membranes around structure A, credit was not given for the function of the organelle but was given for the idea of compartmentalisation or regulating entry into or exit from the organelle. Some candidates answered in terms of the cell rather than the organelle and these were not credited.
- (d) Most candidates recognised that water enters the structure but, once again, cells were frequently referred to instead of an organelle.

Question 2

This question discriminated well. Most candidates followed the instructions and included both ticks and crosses in the table. It was noted that the incidence of 'hybrid' ticks is still significant, and examiners will only credit if the candidate's intended answer is unambiguous.

Question 3

- (a) Most candidates were able to correctly identify the period in (i) as interphase. (ii) discriminated and the main reason for candidates failing to gain marks was a lack of precision in the response. Candidates are expected to use the term 'genetically identical', rather than vaguely referring to 'similar' or 'the same', when describing the products of mitosis. Marks were available for describing the daughter cells or comparing the daughter cells with the parent. Answers often did not mention which cells were being compared. Candidates experienced some difficulty in answering (iii). This seemed to be mainly because they launched into a standard type answer, rather than adapting the response to take into account the information given in the figure and table, both of which referred to DNA rather than to genetic material, chromosomes or haploid and diploid. Many responses simply restated the information given in the question instead of stressing the need for doubling the DNA content. Those that stated 'it increased in stage S' did not score but a statement such as 'it is vital that the DNA content increases from 20 to 40' would be credited. A significant number did not identify that the DNA content was doubling and then halving. Those who did refer to DNA often did so in terms of enough DNA for the process rather than emphasising the need to maintain the DNA content from one generation to the next.

- (b) Some good and clearly explained answers were seen to (i) but many candidates simply repeated the information about p53 that was given in the question. Examiners were looking for deductions concerning the lack of p53 rather than the normal role of p53 in regulating the cell cycle. The choice of words can also be important in this context. Candidates should be encouraged to use the most appropriate terms – in this case, uncontrollable rather than continual; mitosis or cell division rather than reproduction or replication. Although many candidates had some idea of the factors that result in cancerous growth, the main reason for the loss of marks was vague and general answers, such as ‘carcinogens’.

Question 4

- (a) Most candidates made a suitable suggestion of either hawk, snake or owl in (i). Fewer candidates answered (ii) correctly, the most common incorrect answers being mouse or rabbit. It was noted that those who answered (i) incorrectly almost invariably also answered (ii) incorrectly.
- (b) A suitable food chain was supplied by the vast majority of candidates. The reasons for marks not being awarded included a lack of arrows, arrows pointing in the wrong direction and a food pyramid or web instead of a food chain.
- (c) Candidates found it reasonably easy to score two marks in (i). The idea of a large surface area was well recognised but not always associated with a correct description. In some cases, for example, the root hairs were described as branched. A common error was to state that the cell membrane was thin, whereas this should have referred to the cell wall. There was mention of water potential and concentration gradients but many candidates failed to score a mark as their response was not comparative or it was not clear as to which direction the gradient went for the substance they had chosen to exemplify. Overall, full marks for this section were rarely awarded. (ii) discriminated well, with some good and clearly explained accounts. Candidates were expected to recognise that the concentration of nitrates would be lower in the soil than in the root hair, resulting in the need to transport them against the concentration gradient. There was some confusion relating to how active transport and facilitated diffusion work in the minds of some candidates. Others suggested, incorrectly, that the nitrate ions would be dragged in together with water during osmosis.
- (d) Those candidates who read the question carefully realised that they needed to explain the importance of *Rhizobium* in the nitrogen cycle rather than describing the establishment and function of the bacterium in root nodules. Although the details given might have been correct, they would not score highly in the context of this question. The other common mistake was to describe the nitrogen cycle, mentioning *Rhizobium* in passing. As has been noted in previous reports, there is a great deal of confusion in the minds of candidates concerning the names of the type of bacteria involved in the cycle, the processes and the sequence of events. There were few comments on either the enrichment of the soil upon the death and decay of plants or the transfer of organic forms of nitrogen from plants to consumers. Hardly any references to legumes being able to grow in impoverished soil were seen

Question 5

- (a) Surprisingly, many candidates were unable to name the pentose sugar in DNA. Many stated ribose, rather than deoxyribose, or deoxyribose was misspelt (often as dioxyribose).
- (b) This part of the question discriminated well with those candidates who actually answered the question in the terms that were required. Weaker candidates find it difficult to distinguish between DNA replication and protein synthesis. Some, presumably relating to their response to (a), described the behaviour of chromosomes during mitosis. Potentially correct answers often lacked clarity, such as referring to bases or strands when meaning nucleotides; describing the new DNA molecule as half old and half new rather than indicating that one strand was original and the other was newly formed. The majority of candidates started their answer by stating that the DNA double helix would have to be unwound and unzipped. Many also appreciated that hydrogen bonds between the bases would be broken in order separate the two DNA strands. While some candidates then

continued to describe the formation of mRNA, many understood that free DNA nucleotides would then align opposite their complementary bases, giving detail of both the pairing of adenine to thymine and cytosine to guanine, as well as the number of hydrogen bonds that would form between each purine and pyrimidine. Some also commented that the free nucleotides would be activated by the addition of two extra phosphate groups. Many linked the formation of the sugar backbone with DNA polymerase although mention of the phosphodiester bond was rare. Even weaker candidate who had gone astray earlier in their answer stated that DNA replication would be semi-conservative, often adding that the new DNA molecules would comprise one old, or original strand and one newly synthesised strand. The QWC mark required a response of 12 lines of writing or more and most candidates were awarded a mark for acceptable spelling, punctuation and grammar

Question 6

- (a) Only the more able candidates successfully answered (i), the more common incorrect answers being sulphide, hydrogen and ionic. (a)(ii) and (b)(ii) proved to be a problem for those candidates who had not read through the question and did not appreciate the difference between the two parts of the question. In (a)(ii) candidates were expected to deal with the effect on the structure of the enzyme molecule. Detailed comparison of the possible types of inhibition was not appropriate but the actual change in the shape of the molecule and active site and the implications for the complementary shape and the formation of the enzyme-substrate complex did address the question. These observations could be made in the context of competitive or non-competitive inhibition. Responses were commonly repetitive and statements imprecise, although some clear and concise explanations were also seen.
- (b) Most candidates were able to make a suitable suggestion in (i), although some candidates appeared to think that the apple would be contaminated with lead or tin, which would not be desirable in a food product. As suggested above, many candidates referred to the structure of the enzyme molecule in (ii), instead of concentrating on its activity and the information provided in the graph. This meant that such a response was limited in the number of marks available. More able candidates recognised that the lead ions would act as a non-competitive inhibitor although references to both competitive and non-competitive were not credited. Many also understood that inhibition would be permanent and commented that the reaction would not occur or that the enzyme would show no activity. Generally, there was a poor understanding that the graph showed the effect of increasing the substrate rather than increasing enzyme concentration, so there was little mention of the fact that increasing substrate concentration would have no effect on the rate of reaction in the presence of lead ions.

2802 Human Health and Disease

Nearly all candidates attempted all questions.

Questions generally well answered were 2 (c) categories of diseases; 3 (a)(ii) describing trends shown in data; 3 (c) using information; 4 (both parts) on diet and health; 5(a) cigarette smoke, 5 (b)(ii) and 6(b) how ring vaccination helped in eradicating smallpox.

The areas of the specification that seem to cause most problems for candidates were: immunity, causative agents of infectious diseases, methods of transmission of infectious diseases, antibiotics and antibiotic resistance in bacteria, calculating percentages and correctly identifying structures as seen under a microscope.

Some candidates lose marks by giving vague answers, as indicated in the comments below on responses to individual questions.

- 1 (a) Just over 25% of candidates correctly identified all the structures in the diagram. Some candidates failed to pick up the clues of blood cells, and therefore did not identify Q and R as blood vessels, or they failed to use the clues of wall thickness to identify Q as an artery and R as a vein. Most candidates correctly identified P as an alveolus.
- 1 (b)(i) This was well answered, most candidates indicating that the elastic fibres allowed the alveolus to stretch/recoil or to prevent it bursting. A few candidates lost marks by describing the action of the elastic fibres as contracting and relaxing.
- 1 (b)(ii) The majority of candidates did not look at the diagram and based their answers on alveoli. Q is a branch of an artery/arteriole and the smooth muscle is for vasoconstriction, although regarding Q as an artery and referring to maintaining blood pressure also scored, but saying that the smooth muscle is for pumping blood did not score.
- 1 (b)(iii) The majority of candidates answered this well, referring to moving mucus. Those that lost the mark did so because they referred to what was trapped in the mucus but did not actually mention mucus.
- 2 (a)(i) Most candidates scored one mark here for referring to disease as a departure from good health or from physical or mental wellbeing. Many failed to achieve the second mark as they did not link their answer to a malfunction/abnormality of mind or body.
- 2 (a)(ii) Most candidates scored 1 or 2 marks and about a quarter scored 3 marks. Many lost marks by being vague. They referred to weight loss and not extreme/rapid/sudden weight loss. Candidates should focus on symptoms specific to anorexia, such as obsession with body image rather than giving vague references to depression. Few mentioned low blood pressure, weak immune system, lanugo or cold hands and feet.
- 2 (b) About half the candidates scored 1 and a third scored 2 here, so it was well answered. Most referred to targeting education or advice but fewer mentioned screening or use of schools/advising parents or teachers/ use of magazines or role models.
- 2 (c) This was well answered. Most candidates scored either 3 or 4 marks. Candidates lost a mark for vague references to 'diseases that get worse with time' or 'wear and tear on the body due to ageing' for 'degenerative' instead of the expected answer which was 'a gradual loss of function or progressive deterioration of the body.'

Report on the Units taken in January 2009

- 3 a (i) The majority of candidates scored no marks for this question and only one quarter got both marks. Very few seemed to know how to calculate the percentage change.
- 3 a (ii) This was well answered, with most candidates scoring two or three marks. Most recognised that more men than women were infected; the numbers had increased and most quoted figures to support their argument. Some referred to the dip in numbers for men in 1999 and for women in 2003, followed by a steeper increase. However some lost the mark by not reading the graph carefully and giving wrong dates.
- 3 (b)(i) This was surprisingly not well answered. Only just over half the candidates knew Mycobacterium (tuberculosis or bovis). Some of those spelt it incorrectly, such as Microbacterium, and did not get the mark. Some guessed at Plasmodium/Vibrio or bacterium tuberculosis.
- 3 (b)(ii) Most referred to droplets but many gave vague answers such as 'airborne' which was not enough. Some gave coughing as the second answer but this was alternative to droplets. Very few mentioned sputum or saliva. Some mentioned unpasteurised milk or eating contaminated beef but vague answers such as 'milk and meat' did not score. Some had no idea and guessed at 'water borne/lack of hygiene/poor sanitation'. The majority of candidates scored just one mark.
- 3 (c)(i) A few candidates did not use the information in the table and hence did not answer the question. Some gave half the story - that people had moved away but then failed to say that they were spreading the disease in the new area. Some quoted figures correctly to support an answer. Three quarters of candidates scored two or three marks. They referred to the long length of treatment, the fact that some give up treatment and that some people are hard to follow up and may be spreading the disease.
- 3 (c)(ii) Only the very best candidates scored here. Many lost marks by referring to TB as being resistant, rather than the pathogen being resistant. Many are still confusing resistance with immunity and some are confusing resistance with antigenic concealment and giving reasons why vaccines are ineffective. Many think that using antibiotics prevents mutation and will prevent the bacteria from becoming resistant, rather than recognising that there are many strains of the bacterium, some strains being resistant to one or more antibiotics and that some antibiotics are ineffective against some strains. A few candidates refer to 'strands' of bacteria instead of 'strains.'
- 4 (a) This was well answered. Most candidates scored 2 or 3. A few confused the effects of vitamin A deficiency with the effects of vitamin D deficiency. Some gave rather weak descriptions instead of using the term 'rickets'.
- 4 (b) This was generally well answered with about three quarters of candidates getting half marks or more. However there were still many vague references to 'clogged' arteries and many still referring to plaque being 'on' the artery wall and not 'in' the artery wall. Some are referring to high levels of cholesterol but in the diet, and not in the blood. Many referred to high blood pressure and did not link it to diet, such as salt or alcohol. Many spoke of the heart, and not the heart muscle, being deprived of oxygen or glucose due to atherosclerosis in the coronary artery. Few made reference to protective foods, such as antioxidants, (soluble) fibre or fish oils. Some ignored the question and wrote about the link between smoking and coronary heart disease.
- 5 (a) This was very well answered with nearly all candidates achieving 4 or 5 marks. Some lost a mark by saying 'gases' instead of 'oxygen' or by not knowing the word 'carcinogen'.

Report on the Units taken in January 2009

- 5 (b)(i) Only one third of candidates scored two marks here. Most referred to release of adrenaline and some referred to increased heart rate or increased stroke volume or cardiac output. Very few referred to vasoconstriction of arterioles. Many referred to nicotine making platelets sticky and causing a stroke, which was not the expected answer.
- 5 (b)(ii) This was generally well answered with more than two thirds of candidates scoring 2 or 3 marks. However some candidates give three different versions of the same answer, such as three types of anti smoking campaigns/advice. Many lost a mark by referring to banning smoking and not to banning smoking in public places. However many correctly referred to increasing the price/taxation of cigarettes, raising the age for buying cigarettes and tougher penalties for those selling cigarettes to underage people.
- 6 (a) This was generally well answered and well understood. Over half the candidates referred to antigenic material, an immune response being stimulated, memory cells being made and remaining in the body so that the secondary response is much quicker. A few candidates think 'pathogen' and 'antigen' are synonymous and some confuse antigens and antibodies and some seem to be confused between antigens and antibiotics.
- 6 (b) This was well answered. Many referred to the fact that the disease was contained as it could not spread.
- 6 (c) Some candidates lost marks by referring to 'it' rather than the smallpox pathogen/virus. Hence they lost the mark for the idea that the virus is stable/does not mutate. Some think that the vaccine could be frozen, as opposed to freeze -dried and some referred to quickly treating patients rather than identifying cases and vaccinating people in the area. A surprising number of candidates think that immunity gained from vaccination of parents is inherited by their children. Only about 25% of candidates scored three marks and 25% scored no marks.

2803/01 Transport - Written Paper

General Comments

The marks covered virtually the whole range available and the performance of the candidates was very comparable to that seen in previous January sittings of this paper.

Most candidates seemed well prepared but there was some evidence that a few had not really revised the material and either left sections blank or wrote irrelevant material. Some of the questions approached familiar material from a slightly different angle and some candidates seemed to find it difficult to 'think outside the box'.

There was no evidence that candidates were short of time.

Comments on Individual Questions

- Q.1 It was pleasing to see that the plant orientated question produced a range of scores very much in line with the other questions as there has been a tendency for candidates to under-perform on this type of question compared to those on animal topics. As a whole, the question discriminated well, but part 1(c) was not well answered.
- (a) This proved to be a fairly easy opening question with well over 40% of candidates getting full marks. The commonest cause of lost marks was to fail to appreciate the difference between 'setting up the experiment' – as asked in the question – and running the experiment. Thus, ideas like 'keep conditions constant during the experiment' did not score. Weaker responses included vague references to holes in the capillary, making everything firm and not tilting the apparatus. These again did not gain credit.
 - (b) This was a 'describe and explain' question. Marks were available for indicating that both conditions increased the rate of uptake / movement of the meniscus supported by one suitable data quote. Some candidates produced inappropriate data quotes by comparing a figure for e.g. low wind speed and temperature with one where both conditions were high. Although most candidates got the idea of increased transpiration, few made the link to increased transpiration pull moving water up and therefore in. There were also the responses to wind which invoked the blowing away of water not water vapour
 - (c) This was the first question where candidates were asked to 'think outside the box'. They found it difficult and a number omitted it altogether. Some suggested things that might increase the rate of movement not reduce it. Many suggested it was related to photosynthesis and that the cut shoot did not photosynthesise or that the whole plant might have had several shoots so each one would have a slower rate. Very few were able to make the link that the whole plant would have roots and thus the uptake at the root might reduce the rate. The subsequent passage across the root tissue to the xylem would meet more resistance than in the photometer shown. Even the availability of water (if the whole plant was still in soil) might have an effect.

- (d) Candidates got back on track here and the question discriminated well – though a significant minority talked about phloem rather than xylem. Common errors were just to talk of ‘continuous columns of water’ rather than a clear statement about the lack of end walls. There are still candidates who think lignin stops vessels bursting rather than preventing collapse. Some candidates put cohesion and adhesion in together in the hopes of scoring a mark. Centres should be aware that the cellulose portion of the wall is where the adhesion occurs and that the idea that lignin adheres to lignin (which appears in some texts) is at best debatable.
- Q.2 Questions on the basic principle of surface area to volume ratio have been set before and it was encouraging to see that candidates seem to be getting to grips with the principles involved.
- (a) The key ideas looked for were that *Amoeba* has a large surface area to volume ratio and that the diffusion distances are short and so the speed of diffusion is adequate to supply the cell. In humans, the cells deep in the body mean the distances are too great to be served by diffusion as it is too slow. General ideas of making diffusion ‘more efficient’ were not credited. Some candidates seemed to think that diffusion was faster in *Amoeba* than in humans. The need for a circulatory system can also be related to the greater activity of humans.
- (b) This proved an accessible question. A common error was to just state alveoli unqualified rather than to relate them to a large surface area and a thin wall (but not thin cell wall) and thus short diffusion path. As the question only asked for features to be stated, examiners decided to allow ‘moist’ – but centres should be aware when preparing candidates that being moist is to maintain the integrity of the alveolar wall, not to make diffusion ‘faster/easier’ as candidates often suggest.
- Q.3 Overall this question produced a good spread of response, but 3b was asked from a different angle and not all candidates appreciated this.
- (a) Although about two thirds of candidates got the correct answer (75), a significant number multiplied rather than divided and got 48. There were a few answers as low as 1 and as high as 100+. This question also had the largest number of cases where no answer was attempted
- (b) The graphical data in this question should be familiar to candidates, but in the past they have been asked to identify what has happened at points like X and Y. This time they were given the answer and asked to explain why. Thinking like this proved tricky and even some of the more able candidates did not use the graph to pick up the two marks for stating that ventricular pressure exceeded/reached arterial pressure at X and ventricular pressure equalled/dropped below atrial pressure at Y. The appropriate pressure (differences) then needed to be linked to the valves opening. Too often the sequence was wrong: the valves opened after the blood had entered the next region or opened so the pressure could change. Arteries and atria were sometimes confused as were the two valves. On the positive side there were some excellent answers which followed the sequence through logically and clearly showing thorough understanding
- (c) Candidates were more successful in using the data here. Most got the idea that the left side showed more pressure as the blood passed to the body rather than the lungs – though some thought the right side was related to the head or heart. Fewer realised it was a difference in ventricular pressure and so risked missing a second mark.

- (d) The whole mark range was used in the extended writing answers. Good answers contained detailed descriptions of the make up of the three-layered wall, the valves and the wide lumen using the correct biological terms. These features were then clearly related to their functions. There were a few who wrote about arteries and there are still candidates who think that the smooth muscle reduces friction or that the thin wall allows exchange.

Q.4 There was some clear understanding shown here.

- (a) A few candidates failed to score here, usually by inverting their answers or by thinking the red blood cell was a platelet. The vast majority got the red blood cell correct however. Candidates were less successful with the phagocyte with many candidates just putting white blood cell.
- (b) (i) The answer looked for was the difference in protein content, with tissue fluid having fewer or none. The bathing of tissues as opposed to contained in the vessels was also credited. Many candidates talked in terms of the presence or absence of blood cells. This was treated as neutral. Blood as a whole tissue contains plasma and cells – thus the cells are not part of plasma.
- (ii) Although this question differentiated well, only the best were able to score the maximum. The key ideas are that there is a pressure involved – not just diffusion, that this pressure is at the arteriole end of the capillary bed (or due primarily to pressure from the heart) and that there are gaps between the endothelial cells of the capillary wall which let fluid through.
- (c) Although only about 5% of candidates failed to score here it showed a good discrimination across the mark range. The atom to which oxygen binds was sometimes given as H or N. 8 molecules of oxygen were sometimes quoted as binding to one haemoglobin molecule. The Bohr shift was described as the dissociation curve on several occasions. It was good to see many candidates can now quote carbonic anhydrase correctly, but there were still some carbonyl, carboxyl or carbons given, carbonic acid and even totally unrelated enzymes. Haemoglobin acid was the least well answered section. Myoglobin, hydrohaemoglobin, carboxyhaemoglobin and carbaminoglobin all appeared not infrequently.

2803/02 and 2806/02 Coursework 1 & 2

General comments

The general standard of work submitted has seen an improvement this year. Most centres are achieving a high standard of marking with good quality annotations. In contrast, a few centres are using newly qualified teachers or personnel lacking experience in coursework teaching and marking. It is strongly recommended that such centres take advantage of the consultation service available to check the validity of an assessment exercise and its marking.

There remains a significant core of incorrect entries where centres intended candidates to carry forward their last coursework score but entered them for new work. This causes confusion and delays the process of moderation in general.

A number of scripts were seen this year where the centre had produced extensive annotation of every descriptor except P3b and yet had awarded this point. Quite large adjustments can result from this simple error. A general rule for candidates planning range and replicates is 5X3. Clarity is the essence here; the candidate must state unambiguously his/her intentions whilst the centre may not infer P3b from a results table. If the skill I used does not have three replicates, an appropriate mean can not be calculated making A1a difficult to award; some parts of the 'b' strand of skill E become more challenging too.

The generation of graphs using ICT skills is often fraught with unexpected difficulties. To satisfy A3a, a graph must be adequate to permit the extraction of new information from the existing data. In order to do this it must be large enough and have both major and minor grid lines for both axes. A5a (carries out detailed processing of evidence and analysis including, where appropriate, the use of advanced numerical techniques such as statistics, the plotting of intercepts or the calculation of gradients) can **not** be awarded for a perfect graph whether it follows IOB guidelines or not.

The level 5 descriptors E5ai and E5bii cause a number of centres difficulties. Where a candidate has included what is obviously the major limitation (E5ai), they must explain why it is so and the consequences; centres may not credit this unless it is unambiguously acknowledged by the candidate. Similarly E5bii is often missed by candidates who do well in this context in the 'a' strand. Skill E is, by definition, more challenging than the other skills. It is noticeable that E7a and E7b are rarely attempted by weaker candidates. The former can be made more accessible to weaker candidates comparatively easily by teaching them to add a suitable sentence to each improvement suggested.

2806

Specific comments

The use of poor quality of scientific knowledge and understanding (SKU) in skill A is a cause for concern. Where a candidate has employed a complete investigation for the assessment of skills P and A, it can be that the SKU in the plan is of excellent quality and relevance, but the conclusions are not supported to the same standard. Along the same lines, the majority of centres are teaching the need to use AS and A2 SKU well but candidates commonly offer only AS or A2 SKU to support their conclusions. If only AS SKU is offered then it is very unlikely that A5bi be matched quite apart from the synoptic descriptors.

2803/03 Practical Examination

General Comments

As in June 2008, the Examiners used a mark scheme with further elaboration of the checking points for marking the Plan. It is hoped that this provides some useful advice when preparing candidates for the practical examinations in May 2009. It was clear, yet again, that advice in these reports about the citation of secondary sources is still being ignored by candidates with the loss of an easy mark. Most candidates had worked out a reasonable approach to this investigation. Only a few candidates failed to submit a Plan.

The January date for this examination is always something of a challenge for all concerned. Laboratories are often cold. This was evident in Q.1 of the Practical Test as results collected by the candidates were often not as good as trials carried out before Christmas. This fact was reported by several centres. Also it is assumed that many candidates write their Planning exercises over the Christmas holidays. This planning exercise on the denaturation of two plant enzymes that hydrolyse gelatine was especially suitable for preliminary work at home. As in previous sessions, the quality and extent of the preliminary work was variable. It is a shame that few candidates undertake this valuable part of the exercise with the rigour it deserves. The Examiners observed that few candidates were able to access the full range of marking points as a result. Some appeared to have done none at all. Very few candidates gained the full 16 marks.

The vast majority of candidates gained suitable results in Q.1 and were able to describe a trend. Few achieved very high concentrations of betalain as expected. The Examiners have to report that they were disappointed that some candidates totally ignored the information given on page 2 of the Test when answering (b) and (c). The evaluations in (d) were generally much better. However, few could explain the reasons for the initial washing of the beetroot discs. Some candidates thought that, like the Plan, this was an investigation into the effect of temperature on denaturation of enzymes. Some candidates seem to find it hard to 'change gear' from one part of the paper to another.

The drawings in Q.2 were generally poor, but a generous mark scheme ensured that candidates who had made appropriate observations and knew about mitosis gained marks. They often compensated for a low score on Q.1 by gaining a mark between 10 and the maximum of 16 on Q.2.

Nearly all plans were neatly typed on A4 paper, using a reasonable sized font, with the centre and candidate numbers on every page which made the marking much easier. Very few candidates exceeded the maximum word count.

The candidates often provide some unwitting amusement. The Examiners liked 'dependable variables', 'drop in pipettes', 'cork boards' and 'prongs and thongs' for removing hot test-tubes from water baths.

Comments on Individual Questions

Planning Exercise

This Planning Exercise gave the candidates the choice of using actinidin from kiwi fruits or bromelain from pineapples in their investigations to find the lowest temperature at which these enzymes are denatured. The candidates were told to use gelatine as the substrate in this investigation. Some candidates thought that this was a typical 'effect of temperature on the rate of enzyme action' investigation and wrote their background material appropriately. This was not the case. The rate of gelling was not necessarily the best variable to investigate here as the homogenate containing the enzyme was given a heat treatment *before* being added to the substrate. Some candidates did not appreciate this and kept enzyme and liquid gelatine at a variety of temperatures. If they had done this with a suitable control such as water in place of the homogenate they would have found that a gel does not form at most of the temperatures they decided to investigate.

Most candidates added heat-treated fruit extract to liquid gelatine and checked to see how long it took to set or whether it set at all. Some stated that they would leave it for a matter of minutes before checking. Others, more sensibly, left the fruit extract gelatine mix for several hours before checking. Those candidates who put blocks of gelatine into the fruit extract had a much better approach that led to a good quantitative analysis (see **Q** below).

The standard of supporting theory was relatively weak although the expected material was neither difficult nor extensive. Planning Exercises on enzymes tend to prompt the Wikipedia illustration of active sites and a discussion of all the variables that influence enzyme activity.

The rest of the report should be read together with the mark scheme.

- A** Some of the suggested plans were unworkable for one reason or another. One problem seemed to arise from the nature of the exercise. It was not appropriate to keep the fruit extract gelatine mix at the temperature being tested. It is necessary to cool the gelatine before adding the extract otherwise the enzymes are likely to be denatured anyway. As candidates pointed out the temperature at which the gel was left to set is a controlled variable. In many cases it was the temperature of the refrigerator (4 °C). Some candidates did not give long enough for the heat treatment of their extracts nor did they give long enough for gels to set.
- B** The majority made a clear statement relating a stated temperature for solidification of the gel or enzyme denaturation, but many simply related the effect of increased temperature on the denaturation. Most candidates gave a suitable temperature or temperature range for denaturation. Some gave their prediction after testing a range of temperatures so gaining **J** and **B** together.
- C** Most candidates selected appropriate apparatus often giving a very exhaustive list justifying every last test-tube and Petri dish. Some omitted a thermometer which they would need to check the temperature of their water baths and the temperature of the gelatine before adding the extract. Those candidates who added extract to molten gelatine should have realised that the temperature of the molten gelatine had to be the same as or lower than the lowest temperature that they tested. Some candidates had complete faith in their thermostatically-controlled water baths to work perfectly. Perhaps centres should ensure that candidates check the actual temperature of the water in these water baths against the temperature on the dial.
- D** Few stated that the enzymes hydrolyse peptide bonds. Some said that bonds break, but did not name them.

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- E** Although factors to control were often correctly identified, some candidates simply gave a list of factors affecting enzyme activity, without saying that they would control these factors or keep them constant. As in previous sessions, candidates referred to 'amount of' when they meant volume or concentration but did not make it clear which. If this was the case they were not awarded **L**.
- F** Almost all candidates were awarded this point with the vast majority appreciating the need for at least five different temperatures, although there were some who only gave four.
- G** This was usually awarded with **F** except when candidates gave a very narrow range of temperatures. Some tested a wide range in their preliminary work and a narrow range in their main Plan. If this was the case then **G** was awarded for the preliminary work (as well as **J**).
- H** Most candidates recognised the need for three or more repeats to improve reliability.
- I** There were scripts that showed evidence of excellent and relevant research, but in many cases this aspect was not well done with lengthy accounts of 'lock and key'. Most candidates wrote about the influence of variables on enzyme activity rather than explaining what happens when enzymes denature at high temperature. This aspect does not need to be lengthy. It does need to be relevant.
- J** As in May 2008, candidates often described the preliminary work that they *would* do. Candidates only gain this marking point if they describe their preliminary practical work and then say how this has informed their plan. There was a variety of ways to achieve this mark and occasionally it was given for a thorough investigation of the volume and concentration of the gelatine to use. Some investigated different ratios of gelatine to water and chose a recipe that generated fast setting times. Many were still unaware of the purpose of a pilot study.
- K** This was not a practical with an obvious safety aspect. Candidates should always carry out a risk assessment and state the risks involved and give an appropriate safety precaution. As in previous sessions most gave some hazards but stated what to do in the case of an accident or emergency rather than listing precautions to avoid accidents. Even a simple exercise like this has its hazards, such as allergy to enzymes, cutting with knives and use of very hot water. Appropriate precautions would be use of gloves and safety goggles, cutting on a tile or board and cutting away from the body and use of protective gloves or test-tube holders. In general, candidates miss this marking point by not being specific enough.
- L** A number of candidates were not awarded this mark as they presented poorly written Plans that did not make clear the sequence of events in the method. Some were confused between the source of the enzyme – the gelatine or the fruit juice – and so did not gain any credit.
- M** The Examiners were pleased to see some candidates consider ways to record quantitative results. Some put weights on the gelatine and measured how far they moved. Some used a viscometer. A common suggestion was to put the jelly into a sieve and measure the volume of the filtrate. Others put blocks of gelatine into the fruit extract and determined the percentage loss in mass. Others put the extract into a well in a Petri dish full of gelatine and measured the diameter or volume of gelatine that was digested. Ideas that did not gain credit were timing how long it took the gel to set and tilting the jelly to an angle of 45° and measuring the percentage gelation.
- N** Most candidates were able to give relevant information, but some failed to cite their references in the text, so did not receive credit. This seems to be a perennial problem and

one that is easily solved by appropriate advice to candidates. Centres should remind this cohort of candidates about the need for citing references in the text before they take the A2 practical examination in June this year. Centres should advise their candidates always to check the facts that they find in Wikipedia entries by looking at reputable web sites or even by looking in some books.

- O** A very simple table was required as the minimum acceptable answer. This showed the temperatures of the heat treatment and ticks and crosses to show if the gelatine had set or not. No units were required for the dependent variable as qualitative data would be collected. Those that had a quantitative method gave better tables showing the loss in mass or the diameter of digestion around a well cut into gelatine in a Petri dish. Many candidates gained this mark.
- P** The spelling, punctuation and grammar in some scripts were very poor indeed in a minority of scripts. It appears that some candidates do not know how to use the spell checker facility of their word processing programs. Some words were misspelt throughout the plans.
- Q** The Examiners required a clear statement about the lowest temperature that causes denaturation of the enzymes. Most candidates thought that a graph would be appropriate, although rarely was this the case and many simply did not work. Candidates often gave the axes for the graphs that they would draw, but did not explain how these would be used to answer the question posed by the Examiners. Those that compared mass loss did this well. They showed that at a certain temperature the mass would remain constant because the enzymes were all denatured. It was good to see candidates identifying the temperatures with very little loss in mass as the range to investigate further (**R**).
- R** Candidates gained this mark if they identified a narrow range of temperatures after looking at a wider range. This mark was only awarded if there was some explanation.
- S** This checking point was not awarded very often, but most usually it was awarded for a discussion of the subjective nature of the results. Candidates often stated that it is difficult to tell whether the gelatine is set or not. This is where measuring the loss in mass method proved more successful.
- T** The Examiners rarely saw any discussion of validity and perhaps this is only to be expected in the January sitting of this examination. Most simply referred to the inaccuracies of the measuring devices that they had chosen but this was not a discussion of validity.

Teaching tip

This is a very cheap and simple practical to set up. It could be used to show candidates the importance of controlling variables and the subjectivity of results taking. They could also compare qualitative results (does it set or not?) against quantitative results (loss in mass after immersion of gelatine in the enzyme extract) and this would be a good idea for introducing the new practical tasks. This practical also introduces the idea of making a homogenate and using it to prepare an enzyme extract. The discussion of validity (**T**) is also useful for challenging brighter students.

Practical Test

- Q.1 The thermal denaturation of beetroot tissue is a standard practical at AS and is often used for coursework. It proved quite a challenge to adapt it to the requirements of the Practical Examination. Inevitably, with biological material there were problems with supply of beetroot and replicating results in January that were obtained when trialling in November. This was especially the case where centres had not started by the date of the Practical Examination and candidates were working in cold laboratories. However, almost all candidates gained acceptable results that they could analyse. Unfortunately, many were misled by the task in the Planning Exercise and thought that this was an investigation into denaturation of *enzymes*. Very few, if any, were awarded full marks.
- (a) Candidates only had to produce a table with two columns – temperature and (estimated) concentration of betalain. This looked very simple for an exercise such as this and most gained four to six marks. A seventh mark was awarded to those who recorded the immersion time. This proved to be a bonus marks for those few that took the hint from the steps at the beginning of page 3. Some just transcribed the times rather than calculating time spent in the water.
- (b) The Examiners initially considered this to be an easy question, but it did not prove to be so. Most candidates did not understand that it was necessary to wash away any betalain from the surface of the discs. Even fewer explained why this was necessary in terms of the validity of results. Most candidates referred to making sure the investigation was a ‘fair test’ by exposing the beetroot pieces to the same temperature. Many thought the experiment was about osmosis, so the washing was necessary to make sure the cells were all turgid. Many thought it would be ‘impurities’ that would be washed away.
- (c) Most candidates gained two marks for describing their results. It was pleasing to see a description of the trend illustrated with data and references to anomalous results. However, few candidates showed understanding when drawing conclusions as they did not use the information given at the top of page 2 to inform their analysis. Most gained marks by referring to diffusion of betalain from the vacuoles following destruction of the tonoplast. Few referred to the destruction of the cell surface membrane as well. Better candidates referred to the structure of the membrane but only the very best discussed thermal denaturation of membrane proteins and increased fluidity of phospholipids although not always in those terms. There were few references to an increase in kinetic energy and a greater rate of diffusion at the higher temperatures. Ideas about osmosis and water potential were carried forward into the explanation with the result that no marks were awarded. Some thought that betalain was an enzyme and a few even suggested the effect of temperature on bromelain.
- (d) Evaluations were better than the analyses of results. Candidates were lucky that the standard responses about subjective results, syringes, controlling the temperature of water baths and using colorimeters were acceptable in this exercise. Many also stated that no repeats were taken and that they should repeat the whole investigation at least twice. There were some more thoughtful answers that dealt with the range of concentrations of betalain and the difficulties with obtaining uniform pieces of beetroot. Some candidates obviously thought they should find the lowest temperature at which betalain starts to diffuse from the vacuole and recommended using intermediate temperatures as they had done in their Plan. This was considered an acceptable answer and

given credit. Several of the marking points on the scheme were rarely, if ever, seen. Although many stated that a colorimeter would improve the results, few gave any further detail (marking points 23 to 26). Some candidates wrote a great deal discussing just a few points. They should know that this will not gain them much credit. Many identified the fact that the discs were not left in the water for long enough and that some rinsing water was left in the tubes. Also mentioned were discs getting stuck together so that less surface area was exposed to the water.

Teaching tip

This exercise lends itself to using a colorimeter and indeed is mentioned in the specification for Unit F211 (learning outcome 1.1.2 (e)). The procedure in this question could easily be modified to do this, although improved with better control of water temperature and longer times for immersion.

- Q.2 Some centres reported difficulties with the slides of root tip that were sent from Cambridge and used some of their own. A few candidates did not score any marks for their drawing skills. It was obvious that candidates from some centres had no appreciation of the skills required. Often they drew what they expected to see rather than they could see. The Examiners felt that some candidates who had tried to draw and interpret what they could see failed to gain marks as they were drawing stages too early or late for one or more of the phases.
- (a) The answers were very variable with few candidates gaining both marks. A common failure was not to indicate which area had the highest number of cells undergoing mitosis by labelling or shading.
- (b) On the whole the standard of drawing in (i) was very poor. Those that drew text book drawings of chromosomes did not gain the drawing marks. The Examiners devised a mark scheme that rewarded observation and recall without penalising poor drawing skills. Candidates who drew text book diagrams of 'stick' or 'sausage' chromosomes did not gain the marks for observing chromosomes. Marks were needlessly lost by failing to end label lines on the structures labelled. In (ii), label lines frequently stopped short of the cell wall, chromosomes or nuclear envelope. Annotations were somewhat better in (iii) as they were recalled rather than observed. However, many of the annotations for telophase were not about the chromosomes as required by the question. Quite a few candidates confused mitosis with meiosis and wrote about pairing and separation of bivalents in their annotations. Centrioles appeared quite frequently as labels and in the annotations. Plant cells do not have centrioles. It is worth pointing out that it is not possible to see the nuclear envelope, but candidates are able to draw a line around the nucleus and this line represents the nuclear envelope.
- (c) Answers were generally poor here, too. Candidates who gained a mark usually gained it by stating that the chromosomes were 'uncoiled' or were 'long and thin'. Few mentioned the processes that occur during interphase such as protein synthesis and replication. Some thought that interphase is a stage in mitosis. Some candidates missed this question.

Teaching tip

Drawing from the microscope is likely to become a thing of the past. However, it is still a useful skill in observation and recording and may well be required in the new practical tasks. It is hoped that candidates will still carry out root tip squashes to see mitotic figures and compare their results with prepared slides. The Planning Exercise in the AS paper set in May 2005 involved carrying out such preparations. A technique that is highly recommended uses toluidine blue and is given in Student Sheet 17 on the SAPS website:

<http://www-saps.plantsci.cam.ac.uk/worksheets/ssheets/ssheet17.htm>

2804 Central concepts

General Comments

Examiners felt that this paper was comparable in terms of difficulty to January 2008. In both the extended answer questions, there was a lack of precision when using biological terms and many candidates failed to make good use of the information provided. Both calculations caused more difficulties than expected. The examination paper seemed of appropriate length and there was little evidence that candidates had run out of time.

Comments on Individual Questions

Q.1 This question did not prove to be the gentle introduction to the paper that it was intended to be. Many candidates had a good grasp of the structure of ATP but were unable to accurately express the role of this molecule in cells. It appears that centres teach the details of respiration and photosynthesis well but give too little consideration to the central role of ATP in cellular metabolism.

- (a) A simple diagram of ATP was provided as stimulus material to name the different parts of the molecule. This proved to be the undoing of a significant minority who confused F and G. An avoidable error caused by not studying the diagram carefully enough. F was often called adenosine and G sometimes ribulose.
- (b)(i) This section was surprisingly poorly answered. Relatively few candidates realised that this was a hydrolysis reaction and that the molecule involved is water. Examiners did credit references to ATPase. This reaction is covered in detail in both of the published texts (Biology 2, Cambridge University Press and Essential A2 Biology for OCR, Nelson Thornes).
- (ii) Relatively few candidates knew the correct value for the amount of energy released when a mole of ATP is broken down. Values do differ slightly depending on the text. Examiners were looking for any value between 30 and 31kJ.
- (c) In many cases, this section was answered in a very unscientific style. The minority managed to gain all 3 marks. The most common correct responses were that ATP is found in all cells and that it is an immediate form of energy. Too many candidates believed that 'carrier' meant ATP could travel around the body. Centres need to stress that in general ATP is an intracellular molecule.
- (d) This was a good example of a question where candidates were unable to apply their knowledge to an unfamiliar situation. Weaker candidates thought ATP could be absorbed from the host's gut. Many just wrote all they knew about anaerobic respiration following either the lactate or ethanol pathway without specifically referring to how the tapeworm gains ATP. Fortunately most of these candidates gained credit for mentioning glycolysis and the fact that 2 molecules of ATP are gained during the process. Examiners rarely saw reference to substrate level phosphorylation.

Teaching tip

Before going into the detail of oxidative phosphorylation and photophosphorylation, make sure that candidates are clear of the role of ATP as the energy 'currency' of cells. The simple animation at <http://biologyinmotion.com/atp/index.html> will help students understand the basic principles.

- Q.2 This question proved to be a good source of marks for many candidates, who gained a higher ratio of their total marks on this question than on any other, despite it being the question with the most available marks.
- (a)(i) This was well done by the majority of candidates, particularly the first two marks. *Canis* was usually given for the genus and either *lupus* or *Canis lupus* were commonly given for the species. However a significant minority of candidates failed to carefully read the question and suggested *familiaris* for the species. The weakest candidates had clearly not learned this or didn't read the question at all, and included a wide variety of wrong answers, including *Homo sapiens* and *Paramoecium*.
- (ii) The majority of candidates, again, did well. This is a definition that many will have seen on previous papers and have learned, with long strings of common features appearing frequently, along with reference to reproduction and offspring fertility.
- (b) The most common omission from candidates who clearly knew what they were trying to express was a clear indication of the involvement of humans. Many hinted at this, with terms such as "they" or descriptions of dogs "being mated", but usually failed to get this mark. Another common omission was the idea that it is the "best" offspring from the first cross that are mated to produce the next generation. Very few candidates made clear reference to the need to take precautions against inbreeding. A considerable number of candidates also referred to matings taking place "over a long time", rather than for many generations.
- (c)(i) There were those candidates who reversed the responses and scored no marks; "allopatric/geographical" was better known than sympatric or any of its alternatives. It was interesting to see sympatric written as St. Patrick!
- (ii) It was common for candidates to do little more than repeat the types of answers they had given in (a)(ii), but over 10 lines, rather than 3. Clearly these candidates had either not read the question carefully enough or had misunderstood its emphasis on the various species of the genus *Canis*. Consequently, relatively few candidates referred to domestic dogs, red wolves, coyotes etc, contenting themselves with descriptions as to why any organism might be classed as belonging to the same species as another. Additionally there were numerous responses beginning with "Yes" or "No", suggesting that candidates misunderstood the instruction to "...explain whether..." - as meaning "explain why..." not realising that the information showed that there are both pros and cons for the inclusion of all members of the Canidae in one species. The most popular answers revolved around the jackals not being able to interbreed and that they were, therefore, different species.

Teaching tip

The following website from the Los Angeles Museum of Natural History gives a good explanation of artificial selection of pedigree dogs. There is a useful online activity for students.

<http://www.nhm.org/exhibitions/dogs/evolution/selection/artificial.html>

- Q.3 This was generally considered a straightforward question by examiners and therefore it was surprising that many candidates found it difficult to gain many marks.
- (a) Most managed to gain credit here, many picking up full marks for a clear definition of homeostasis, often with added detail of negative feedback and suitable examples. Weaker candidates referred in general terms to conditions being 'regulated' or 'controlled' without using qualifying words such as 'steady' or 'constant'. Some were very vague as to what they understood by 'internal environment'.
 - (b) Some answers were excellent and reflected genuine understanding of reabsorption; others were confused and often hid uncertainty in generalisations. The most common overall error was to refer to ultrafiltration. Candidates discussed the glomerular-capsule boundary and although some continued to make salient points, others stopped there and gained no credit. Another problem centred on what was understood by the proximal convoluted tubule itself. Students sometimes failed to clarify whether they were discussing the tubule lumen or the epithelial cells and it was difficult to credit ambiguous comments. Where candidates made full use of the diagram, however, referring to the steps as shown, answers were invariably logical and very good. Confusion often remained, though, as to which processes were active and which were passive. Weaker students spoke of reabsorption of amino acids in general as an 'active flow from tubule to capillary' or said that they 'diffused from the proximal convoluted lumen into the blood'. Quite a few used the terms 'pump', 'carrier' and 'channel' out of their correct contexts and without really understanding their meanings. It was pleasing to note, nevertheless, that more or less every candidate made a genuine attempt at answering this question.

Teaching tip

Make sure definitions are understood and appreciated at an A level standard. Make sure that candidates make full use of information given in questions and try to sequence events correctly in longer answers.

The following animation is useful when teaching the physiology of the kidney;
<http://www.biologymad.com/resources/kidney.swf>

- Q.4 This was a very straight forward genetics question compared with those that have appeared on previous papers. Whilst most candidates gained excellent marks on the cross in section (b), they generally failed to correctly explain the genetic terms in (a) or gave very vague accounts of the implications of the Human Genome Project in (c).
- (a) This section was not answered well, as the vast majority of candidates did not express themselves clearly. Many failed to define an allele correctly and many incorrectly stated two or more forms of a gene rather than **more than two forms of a gene**. Very few mentioned the effect of the environment on phenotype although just about all candidates referred to observable characteristics.
 - (b) This section was successfully answered by the majority. Gametes were sometimes not obvious but if seen in a punnet square the mark was awarded.
 - (c) Many candidates, even those who had scored well on other questions, put $\frac{1}{4}$ or 25% for their answer. Some incorrectly added the fractions together and ended up with $\frac{1}{8}$ or 12.5% rather than multiplying them. There was a distinct lack of ability to multiply fractions and to show an understanding of probability.

- (d) This section was answered vaguely by a lot of candidates. There seems to be a big misunderstanding that you can cure genetic diseases by genetic engineering and many candidates referred to cutting out problem genes and replacing them with the correct ones. Relatively few candidates mentioned negative implications such as knowing that you have a disorder for which there is no cure or discrimination by insurance companies and employers. The most common correct responses were the ability to identify faulty alleles, the ability to identify those most at risk and the ability to offer early treatment or advice.

Teaching tip

When setting out answers in genetic crosses, it is helpful if candidates put the gametes they derive from the parental genotypes in circles. The following website gives excellent information on the Human Genome Project.

http://www.ornl.gov/sci/techresources/Human_Genome/home.shtml

Q.5 This question differentiated well. Only the most able candidates gained close to full marks.

- (a)(i) Most candidates correctly identified the Islets of Langerhans as the endocrine tissue found in the pancreas.
- (ii) The majority of candidates know that insulin and glucagon are protein molecules. The second mark proved more demanding as examiners were looking for a little more detail on the molecular structure. The most common correct responses were the fact that the proteins are globular or that they are made up of chains of amino acids joined by peptide bonds.
- (b)(i) Very few candidates were able to correctly read the graph and therefore calculate the percentage increase in insulin concentration in the first 60 minutes after drinking the glucose solution. All too often figures were read off the incorrect Y axis scale, i.e. those for glucose concentration. Many candidates did not read the value for 60 minutes carefully enough and were content to write down 300 units rather than a value between 295 and 299. The value when the glucose solution was consumed was 60 units. Therefore examiners were looking for a value between 235 – 299 units for the increase in insulin concentration. This then had to be expressed as a percentage increase and was often where the mathematics proved too demanding. Examiners accepted any answer between 395 and 399%.
- (ii) To gain full marks on this question candidates had to use specialist terminology successfully. The question asked candidates to explain the effect of insulin on different tissues. Many candidates only mentioned liver cells. Better candidates accessed more marks by referring to muscle and adipose tissue. A number of candidates wrote detailed accounts of the control of the release of insulin from the Islet cells. The only mark they were likely to gain was for referring to insulin entering the bloodstream. Many candidates confused glycogenesis with gluconeogenesis and there was a worrying lack of precision with many answers referring to glucose being broken down to glycogen. The overall impression of the examiners was that this topic was not well understood and that for many their knowledge was barely of GCSE standard.

Teaching tip

Teachers should cover with students the events when insulin reaches its target tissues. They should be made aware that the hormone binds with receptors on the cell surface membrane and that this sets off a series of reactions resulting in increased enzyme activity, increased permeability of the cell to glucose and increased respiration of glucose. The glucose is converted to glycogen in liver and muscle cells and to fat in adipose tissue. A detailed account of the mode of action of insulin for teachers' use can be found at <http://www.medbio.info/Horn/Time%203-4/Insulin's%20Mechanism%20of%20Action.htm>

- Q.6 This question was well answered by the majority of candidates. Examiners felt there was more evidence of centres carrying out field work exercises.
- (a)(i) Even if students had never seen a salt marsh they should have been able to glean enough information from the stem of the question to produce two correct responses. High salt levels and the instability of the mud were the two most common correct responses.
 - (ii) Examiners were looking for responses that dealt with the overall distribution of the five species. Answers dealing with just one species did not usually gain credit. The most common correct answers were that a similarity was the same sequence of species as you move up the shore, and the difference being that all species are found at a higher soil elevation in salt marsh B compared with salt marsh A.
 - (iii) Nearly all candidates correctly identified *Salicornia* as the pioneer species.
 - (iv) Examiners were delighted to see many excellent answers with reference to stabilising the soil, increasing the humus content, raising soil levels and decreasing the salinity.
- (b)(i) Most candidates correctly named two species from *Spartina*, *Limonium* and *Sarcocornia*.
- (ii) Light was the most common correct answer. Examiners did not accept water or nutrients. As in previous sessions examiners will accept minerals or a named mineral but not nutrients.
- (c) Candidates who were familiar with field work correctly stated that a transect would be carried out from the low tide level to the higher ground. They described how a frame or point quadrat would be used and that either the number of individual plants or the percentage cover would be recorded for each sampling site. Good candidates stated that the transect would have to be repeated further along the path for reliability.

Teaching tip

Candidates should carry out a small field work exercise to familiarise themselves with the concept of a transect and how to use a frame and point quadrat.

- Q.7 Examiners felt that this was a good question to finish the paper. It tested candidates' basic grasp of the light dependent and light independent stages of photosynthesis.
- (a) Candidates' knowledge of the structures found in the chloroplast thylakoid and their roles in photophosphorylation was well understood. Understandably the transposition of P and R was the most common error.
 - (b)(i) Good answers were obtained from candidates who took the process to its conclusion. Very few mentioned the possibility that as the atrazine binds to an electron carrier the shape of this molecule is likely to change and that photophosphorylation is likely to stop. Most candidates correctly stated that no ATP or reduced NADP will be produced and therefore the Calvin Cycle will cease to function. This question proved to be a good discriminator.
 - (ii) This proved to be an easy question to gain one mark; usually by stating that the atrazine will not enter the chloroplast. Relatively few candidates went on to explain that when in the vacuole the tonoplast will act as an effective barrier preventing the atrazine affecting the metabolism of the cell.
 - (iii) Candidates scored well on this final section. Most correctly stated that only the weeds will be killed therefore farmers are able to spray their whole field.

Teaching tip

Introducing ideas such as herbicides and how they prevent photosynthesis helps candidates to gain a greater understanding of the process.

2805/01 Growth, Development and Reproduction

General Comments

This paper attracted a wide range of marks between 12 and 82. Most candidates were well prepared and provided full answers which demonstrated to the examiners that most topics had been well covered and assimilated by the candidates. As in previous years, those topics which were synoptic proved a greater challenge and were answered the least well.

Teaching tip

For each topic, candidates could be encouraged to prepare concept maps or mind maps for related topics throughout the specification. For example, reproductive hormones invite links with the endocrine and nervous system. This can be particularly effective in sections where links need to be made between topics or chapters taught by different teachers, to show and highlight interlinking between modules. The mind maps should cover only those topics on the specification for the core papers.

The general standard of the paper was high. Most questions were answered fully and there were few blank spaces which enabled the examiners to make a valid assessment of candidates' knowledge

Several questions involved dealing with data. Many candidates handled the data well and gained credit.

Teaching tip

Some questions require candidates to perform simple calculations, for example to calculate percentages or to work out the magnification of a given item. Many candidates find this difficult, and in particular, are unable to convert between units. To improve on performance in these calculations, it would be useful to practise this type of conversion.

Comments on Individual Questions

Q1 Many candidates found this question challenging, particularly section (a) although section d) provided some pleasing and thoughtful answers.

- (a) Most candidates were able to correctly identify the kingdom *Prokaryotae* to which the organism in the Figure 1.1 belongs. Some candidates incorrectly placed the bacterium in the kingdom *Protoctista*.

Few candidates were able to give the main features of the kingdom. The marks gained were for describing that *the DNA is naked, or is free in the cytoplasm* or that *there is no nucleus*. Also several candidates correctly noted that membrane bound organelles are absent and were able to give examples of these organelles. There were few descriptions of other features such as the nature of the cell wall.

- (b) Several candidates scored both available marks for this section; of the remainder, many candidates measured the line A to B correctly and performed the correct calculation, but lost marks by using the wrong factor of 10 when converting their answer to the correct units specified on the answer line.

- (c) Many maximum marks were awarded for detailed drawings and descriptions of reproduction in bacteria. Some candidates negated the mark awarded for citing *binary fission* by then stating that this is a form of mitosis. This seems to be a common misunderstanding as several candidates drew diagrams of chromosomes aligning along the equator of the spindle and then separating as in a nucleus. Many candidates however described the DNA replicating and a new cell wall forming across the middle of the cell and were credited for this.
- (d) There were several pleasing and thoughtful answers in this section. Many candidates were aware that open wounds and having a weakened immune system would allow MRSA to infect patients more easily. Also many discussed that patients and staff are in close proximity in hospital, thus allowing easy transmission of the bacterium.
- Q2 (a) Section A of this question required accurate recall and those candidates who were well prepared produced many pleasing accounts. A small minority of candidates produced superficial, inaccurate accounts and consequently scored few marks. There were many maximum marks given for describing the development of the pollen from the tetrad shown in the diagram but marks for explaining how the features enable the pollen to carry out its function were gained less often. Many candidates gained marks for describing the formation of the pollen tube nucleus and the generative nucleus (plus subsequent division of the generative nucleus into the two male gametes) but there were fewer marks awarded for describing the function of the pollen tube nucleus, generative nucleus and male gametes. In describing the fusion of the two male gametes some were confused and were unsure which resulting nuclei were diploid or triploid. Again, there were many pleasing descriptions of the formation of the intine, the sculptured exine and the formation of pits, but few accurate explanations of the functions of these structures
- Well prepared candidates gained the QWC mark easily.
- (b) Most candidates gained a mark for correctly explaining that *the resistance to a weed killer would enable the farmer to spray the crop to kill weeds without damaging his crop*. Few candidates went on to talk further about reducing competition or suggesting that the farmer would benefit by having, for example a greater yield of the crop.
- (c) (i) There was a varied response here. Many candidates were able to gain credit by describing the trend of the graph i.e. the further away from the GM crop, the less the percentage of GM modified seeds there were, but many found it difficult to correctly quote figures from the graph as they read the distance axis incorrectly, many confusing the 5m with 10m. However most candidates gained one or two of the available marks.
- (ii) Most candidates were less able to describe how these results could have occurred. There were some pleasing and thoughtful answers which gained credit by discussing cross pollination between the crops by both wind and insect pollination, and how this might have limited the spread of the gene. The most common misunderstanding was to discuss the spread of the *seeds*, rather than the *pollen*.

(iii) Very few candidates could describe a *transect*. Many mistakenly described a *quadrat*, and consequently were unable to gain the marks for describing the transect. On the other hand, nearly all candidates gained a mark by correctly explaining that taking more than one would increase the reliability of the results, although some failed to gain credit by stating that the results would be more *accurate*, rather than more *reliable*.

Q.3 Candidates scored quite well in parts of this question. The synoptic part of the question (c)(ii) proved the most challenging.

(a) Some extremely good answers were seen for this section. Many candidates were able to state that the testes produce hormones, or testosterone and that they also carry out spermatogenesis. The sites of production of both hormones and spermatazoa were mostly accurate and many maximum marks were awarded. Most candidates were able to define an endocrine organ and to correctly apply this to the testes.

(b) Some marks were awarded when candidates described how the *hostile environment in the vagina* may reduce sperm numbers, and also that many sperm may be deformed or lack mobility.

It should be noted that in Advanced Level questions involving the female reproductive system, credit will generally only be given for use of the correct terminology and consequently some marks were lost through failing to correctly identify the female gamete as the *secondary oocyte*. The term *egg* was not accepted.

(c) (i) The vast majority of candidates gained both marks available for this calculation, the only exceptions being when the candidate misread the figures from the stem of the question.

(ii) The common marks gained here were for stating that potassium ions are required for the *transmission of a nerve impulse*, although few candidates went on to say why this would be life threatening (in that the heart or respiratory muscles would not contract). Other responses gained credit by referring to the ionic or water balance being upset, but very few discussed the role in the kidney. Many candidates confused the role of potassium with that of calcium and so failed to gain credit.

(iii) This section required the candidate to note from the passage that *25% of the men did not regain a normal sperm count*, and therefore to deduce that the method may not be reversible. Approximately half of the candidates made this observation and were able to gain the mark, whilst the remainder made random suggestions.

(d) Many candidates answered this 'suggest' question well and were able to describe the effect of high levels of testosterone on the hypothalamus, anterior pituitary gland and the Sertoli cells. Many maximum marks were awarded.

Q.4 The two parts to this question elicited varied responses. Section a) produced a wide range of marks. Section b) was generally well answered. Many candidates only gained marks for the more obvious deductions from the data in the tables.

(a) (i) The symptoms of the menopause were more easily identified than those of premenstrual syndrome although in general there were many varied responses in the table. Most candidates provided a clear decision, whether right or wrong, although a small percentage provided a response which was intermediate between a tick and a cross and so credit could not be awarded.

(ii) The examiners were hoping that candidates would state that premenstrual syndrome is likely to be caused by an imbalance between oestrogen and progesterone, and that these hormones decline at different rates. Very few candidates gained credit for this. Although most candidates realised that oestrogen and progesterone are involved, many were unsure whether the hormones were high / low / declining or increasing.

(iii) Again, most candidates correctly stated that either oestrogen or progesterone is no longer produced or that levels fall during the menopause, but few gained credit than for other than this observation. Many made vague statements such as *the menstrual cycle no longer happens*, and so failed to gain the marks available for more precise statements for example *the ovaries no longer respond to FSH*.

(b) This section required the candidates to study the data in the tables and to discuss whether or not the data supports the statements given. Marks were available for discussion of the data and for doing simple calculations using the data to support or disprove the arguments. Candidates were not asked to explain the findings in the data, and so discussing the roles of the hormones was irrelevant.

Many candidates made relevant observations from Table 4.1, such as that CHD increases after the menopause at all ages and that the risk of CHD increases with age. Also from Table 4.2, the risk of a fatal heart attack if taking HRT is greater, but the risk of a non fatal heart attack is less. Most were also able to quote figures in support of their observations, consequently many marks were gained here, although few gained all seven marks available. Few observed that the differences in the data in Table 4.2 were insignificant, and any more detailed observations from Table 4.1 were also lacking (such as that the rate of increase in heart attacks is greater as the women become older in both groups).

Only a very small percentage attempted to calculate percentages or to work out totals in each category. Some candidates also failed to gain marks by not identifying which group was which, and made observations between *Group 1* and *Group 2* which the examiners were unable to credit.

It was surprising that this question proved challenging to many in all ability groups. However it was pleasing that the vast majority of candidates were awarded the QWC mark for this section.

Q.5 (a) (i) Many candidates gained credit for suggesting that the embryonic cells are undifferentiated, are unspecialised or that they are stem cells.

(ii) All candidates attempted to describe ethical issues, although some of these issues would have been raised by other procedures other than cloning. Many

candidates raised an issue and so gained a mark, but failed to discuss the issue for a further mark. For example, an issue raised might be that *even an embryo has human rights*, or that this might be *considered as murder* or that there might be a *religious objection*. None the less there were several thoughtful and thought provoking responses.

(iii) Nearly all candidates realised that identical twins arise when the embryo splits into two groups of cells which continue to develop independently, although many were unable to describe this clearly enough to gain a mark. For example *the zygote divided by mitosis into two identical cells*. Few candidates gained more than one mark and very few used the term *monozygotic* to describe the twins produced.

- (b) (i) Many candidates gained little credit here. One mark was often gained by saying that the zygote divided by mitosis. Occasionally credit was also given for stating that there was an increase in cell number. Some candidates correctly defined growth and related it to the embryo increasing in mass. Very few referred to the embryo taking up oxygen from the surroundings or nutrients from the ovum. Many went on to describe implantation and differentiation which was not required in this section.

Some candidates mistakenly assumed that IVF had been used and described the conditions which would have been necessary in vitro.

(ii) This section was better answered than (i) in general; candidates gained marks by correctly describing differentiation and specialisation for a specific function or to form tissues etc. The main reason for failing to gain a mark would be by not describing what happens when cells specialise.

(iii) This section was well answered. Most candidates stated that hCG maintains the corpus luteum and were able to describe the effects of this in maintaining pregnancy. Most candidates easily gained two marks. A few failed to gain marks by stating that hCG *signals to the woman that she is pregnant*, without giving more detail.

- Q.6 This question was not answered well by many. Very few candidates were able to correctly identify the method used by these substances to cross the placenta. Few stated that pinocytosis was how antibodies cross the placenta, most candidates assuming facilitated diffusion or diffusion was the method used. Most assumed that calcium ions cross by facilitated diffusion and a variety of methods were proposed for the transport of glucose.

Credit was given for correct descriptions of the method of exchange given, even though it did not relate to the substance being exchanged. For example, if a candidate stated that glucose was exchanged by active transport, they would not gain a mark for stating the correct method used (which should be facilitated diffusion) but credit would be given for correctly describing active transport. In this way, many candidates were able to gain some marks.

Many candidates were correctly able to describe active transport, although less were clear about facilitated diffusion as many assumed that energy is needed for this process to occur.

As few candidates cited pinocytosis as the method used for exchange of antibodies, this process was rarely described. Those candidates who attempted a description often gained the marks available by discussing the formation of a vesicle or vacuole, and possibly by quoting endocytosis and exocytosis in the correct context.

Report on the Units taken in January 2009

A few candidates were able to gain a mark by stating somewhere in their answer that this exchange occurs through the chorionic villi.

The more able candidates were able to gain maximum marks for this question, which was very pleasing to the examiners

2805/02 Applications of Genetics

Question 1

This question produced a good introduction to the paper, and for many candidates this was the one for which they gained most marks.

- (a) The vast majority of candidates realised that this was a triploid and chromosomes would fail to pair, however many failed to say this was in meiosis.
- (b) This subject has been on a number of previous papers and candidates were well versed in how to answer it.
- (b)(i) As usual, candidates suggested this was a store of genes rather than alleles. Also many weaker candidates went into the uses of a gene bank rather than explaining what is meant by the term "gene bank".
- (ii) Candidates who realised this about genetic fingerprinting were able in many cases gain maximum marks for this section. However a number of students tried to describe heritability which is very different from genetic variation.

Question 2

- (a) The synoptic nature of this question threw many students with a significant number thinking the alcohol was converted to carbon dioxide for photosynthesis. The fact that ethanol is toxic was not often noted.
- (b) The key to this question was the realisation that a substitution of an amino acid would cause a change in the three dimensional structure of the protein. Candidates who missed this failed to gain any marks.
- (c)(i) 'Describe' in this context requires a reworking of the figures, we need to see differences in growth e.g. I increases by 28 cm when submerged. Also it was surprising the number of candidates who failed to note that all increased height when submerged.
- (ii) This question was poorly answered. Many suggested ethene was toxic. Very few suggested that plants may fall over or lodge, considering this was evidence that led to the discovery of gibberellins, one would have hoped that candidates had come across this idea before.
- (d) Generally well answered by most candidates. The main error was the mis-conception that genetic engineering would be cheaper.

Question 3

- (a) This question highlighted the problems candidates have when presented with novel situations. Many launched into ideas about inbreeding and the fact Komodo dragons are tolerant of inbreeding. Others latched on to the idea this was asexual reproduction. Very few candidates realised an egg had to undergo mitosis hence it became homologous at all loci.
- (b) Again, most candidates failed to apply their knowledge. Most candidates know YY is an impossible combination in humans and hence they should be able to extrapolate WW is equally impossible for the same reasons. Also because of the work on sex linkage, candidates should also realise that the Y chromosome is almost devoid of genes.

Report on the Units taken in January 2009

- (c) Well answered with many students gaining maximum marks. All points were seen in a number of scripts.

Question 4

- (a) This was again well answered by most candidates although we still have 'resistance' being passed to offspring.
- (b)(i) Figures were often quoted and in many cases these were the only marks gained. Few extended their answer to include differences in protein synthesis. Also, candidates should realise 18 -20 is really an insignificant difference.
- (ii) The idea that a second mutation or series of mutations could have occurred which would have rendered these bacteria more efficient at processing proteins was very rarely seen. Most concentrated on the role of antibiotic resistance as a selective advantage. Many candidates failed to refer to Table 4.1 as instructed.
- (iii) Again most missed the point, and explained how antibiotic resistance could be prevented by reduced use of antibiotics. This was in fact the reverse of what this study indicated.

Question 5

- (a) Most candidates understood that oocytes/eggs held in suspended meiosis had a greater likelihood of damage. However this damage was often described as a gene mutation which is obviously incorrect. Also candidates tended to use examples of trisomy such as Down's Syndrome rather than stating that trisomy had occurred. It was surprising how few candidates mentioned non-disjunction.
- (b) Candidates often missed some quite obvious comments such as the embryo is female, or has not got Down's. It was worrying how many candidates thought trisomy 8 was in fact Down's.
- (c) This question was universally well answered by candidates, many gaining well over maximum marks.

Question 6

- (a) Most candidates were well versed in the subject matter of this question and hence most were able to gain most points.
- (b) Again this was generally well answered by candidates. However, a significant number of candidates who obviously understood the process lost marks because of imprecise answers. For instance, movement of ions does not tell us in which way they move and the candidate should know they are chloride ions. Comments like 'blocks the lungs' is not credit-worthy at A level.
- (c)(i) Again, candidates miss the obvious like an increased percentage of ion channels open as ATP concentration increases for all. Also, the command word compare requires candidates to take specific ATP concentrations and compare opening percentages.
- (c)(ii) As A and B must have different affinities to ATP, the only rational explanation is the binding site must have changed in some way hence that can only happen if the primary structure has altered in that area. However it was rare to see candidates who appreciated this.
- (d) The fact that loss of function was due to the lack of the CFTR in the membrane should have drawn students to the various marking points. More able candidates realised this but the weaker often left this blank or re-phrased the question.

2805/03 Environmental Biology

General Comments

Overall, the candidates performed well in the paper. Candidates were able to answer parts of each question set and there was no evidence that time was limiting. Both long response questions were answered in sufficient detail.

The paper did involve candidates applying their knowledge of biological concepts in different situations and also involved interpretation and understanding of data. The recall from AS and central concepts units was poor with many candidates unable to link information and science together.

Many candidates struggled with describing laboratory methods for soil organic matter analysis and also with techniques of random sampling using quadrats. This suggested that candidates were not used to the techniques required in the specification.

Comments on Individual Questions

- Q.1
- (a) To reach maximum marks here, candidates needed to link the presence or absence of hedgehogs with the associated increase or decrease in lapwing and redshank populations. The candidates needed to use data to back up their answer for 4 marks. Many candidates did not link the information in the stem to the question which says that hedgehogs eat birds' eggs to the possible negative effect these predators might have on the birds.
 - (b) This question brought about many good answers from candidates, with many suggesting that the eggs of the oystercatcher might be inaccessible or unpalatable.
 - (c) Candidates had to outline how small mobile mammals could be both trapped and then marked so that population data could be calculated. Overall this was well done with most candidates using Longworth traps or at least describing them. Many different possible methods of marking were described with the most popular being tagging or fur clipping.
 - (d) This question was poorly attempted by most candidates with little evidence of any Central Concepts understanding. Very few candidates linked the information given to the effects of allopatric speciation and the subsequent genetic effects of small isolated island populations. As a consequence candidates scored poorly here.
 - (e) Most candidates were able to link the lack of enforced legislation of SSSI's with the potential to damage from development. It was pleasing to see good knowledge regarding this subject and the ability of many candidates to explain why SSSI's do not offer complete land protection.
 - (f) This question allowed candidates to use their Central Concepts knowledge to explain how population growth is limited by resource limitation, disease and increased competition. Overall, this was well done by most candidates.

Teaching tip

- This question was generally well done by most candidates with the exception of section d. Knowledge of island populations and allopatric speciation was poor. The following site, <http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/S/Speciation.html> offers some excellent teaching materials on this subject as does <http://www.pbs.org/wgbh/evolution/educators/index.html> .

- Q.2
- (a) Many candidates were able to describe 2 negative effects of aquaculture such as pollution from over-use of pesticides or from fish escaping into the wild. Candidates however often failed to describe the effects of these events on the surrounding environment and so only scored a maximum of 2. There were many different answers from centres for this question which was pleasing and this showed that the question stimulated thought.
- (b) Responses for this question were not good. It involved candidates commenting on the data from a study looking at the effect of pesticide treated food on the lice of Atlantic salmon. Candidate comments lacked detail and most were not supported with any of the evidence available from the table. Very few candidates seemed to observe that the pesticide treated food did not prevent lice infection. Furthermore, it was only after 3 weeks that the effect of non-pesticide treated food did infection exceed that of pesticide treated food.
- (c) Very few candidates failed to realise that the cages were separated by a considerable distance as to prevent cross-contamination of pesticide.
- (d) Most candidates identified two abiotic factors that the scientists would have measured during the study with the most popular being temperature and pH. Many candidates stressed the importance of measuring turbidity, current flow and nutrient level as well as the above two.
- (e) This was a fairly straightforward question of bioaccumulation and the possibility that the lipid soluble pesticide in the fish food could in time work its way through the food chains. Some candidates decided that this question needed to have some link to egg shell thinning and so missed the key point of the question which was about fish!
- (f) This question gave candidates scope to think about how caged 'intensively' reared organisms might differ to wild populations relating to their disease susceptibility. There were some excellent answers given with the most common being the presence of some genetic resistance in wild populations, the fact that they are less densely populated in the wild and so less susceptible to infection and also the possible presence of lice predators in the wild. A good question that was well answered by most candidates.

Teaching tip

There is lots of information at <http://www.seafish.org/sea/aquaculture.asp> which can be used to explain the science of aquaculture and the scale of the operations in the sea. The following site, http://www.clemson.edu/public/regulatory/pesticide_regulation/bulletins/bulletin_10_how_to_prevent_pesticide_related_fish_kills.pdf has some excellent teaching materials looking into the effects of pesticide pollution on fish. This could easily be used as stimulus material for candidates.

- Q.3 (a) Many candidates failed to describe the sampling techniques which would have been used in sufficient detail to be awarded full marks here. It is important at A2 level that candidates describe an appropriate size of quadrat that they intend to use for example. Most did correctly describe the use of a random number generator and the subsequent production of random coordinates.
- (b) This was a difficult question for many candidates but there were some good responses with most correctly identifying that transect data was along a straight line and that the areas of land covered and subsequent habitats may have varied.
- (c) & (d) Most candidates scored full marks for these questions with most identifying that it would be quicker to measure the percentage cover rather than count individual plants and also that this data could be best represented in a kite diagram.
- (e) Overall the candidates who had completed some laboratory practicals did well here and were able to describe accurately the method for measuring soil organic matter content. Too many candidates however provided confusing answers here describing any soil analysis method they had read about.

Teaching tip

The following site, <http://www-saps.plantsci.cam.ac.uk/ecology/lawn/index.htm> contains an excellent resource on how candidates can use random sampling to measure species abundance. Also, <http://www-saps.plantsci.cam.ac.uk/ecology/path/index.htm> enables candidates to use a different method of investigation an ecosystem. This is similar to question 3(a) and (b). The course text book provides sufficient detail for the candidates to follow simple soil analysis techniques and I would like to think that all candidates are prepared for the summer examination having tried and tested all of these methods.

- Q.4 (a) Many candidates failed to explain the effects of increased acidity upon organisms. Lots of responses centred on the fact that fish gills would be affected by a build up of mucus but failed to link this to an increase in the solubility of heavy metal ions such as aluminium. Too many of the answers given by candidates lacked detail required at A2 level.
- (b) Candidates struggled with this question and failed to see the cross-over with Central Concepts material. The limited lifespan of the reed beds would be a result of the build up of the heavy metal pollutants over time. These toxic pollutants will have affected the enzymes in the respiratory chains and also the processes of active uptake on the root hairs of the reeds. The recall of such information from candidates was disappointing.
- (c)(i) Most candidates were able to explain what was meant by the term indicator species with many using an example to illustrate their answer. This was particularly well done.
- (c)(ii) A few candidates here linked the action of aerobic bacteria on sewage polluted water to a decrease in the oxygen content. Furthermore, this lowered oxygen content could then be better absorbed by organisms such as the oligochaete worms which possess lots of haemoglobin. The link between sewage polluted water and the presence of haemoglobin in these worms seemed to confuse many candidates.

Teaching tip

The following information at http://www.epa.gov/med/grosseile_site/indicators/sos/oligochaete.pdf provides some very good teaching materials and data that can be analysed looking at the use of oligochaete worms as pollution indicators. As an organism they are interesting as an indicator species because of their physiological oddities which offer the possibility to link these organisms synoptically.

- Q.5 (a) Most candidates did well in this question and explained that it was the importance of roots in forests at holding soil particles together and so preventing soil erosion. Furthermore, many candidates explained the importance of plant litter, decomposition and nutrient cycling for the health of the soil.
- (b) For this question, candidates were less sure about sustainable forestry than they were about the importance of forests for soil health as in part a. Most scored one mark here with very few describing selective cutting or reforestation of forests as a way of sustaining their future.
- (c) This question required candidates to refer to their previous knowledge on how non-native pests can damage ecosystems. Most of the responses were excellent with candidates identifying the risks to native species through increased competition, the possible arrival of diseases and pests and also the knock on effects upon the food chains.
- (d) Candidates needed to complete the first long answer question of the paper and most made a fairly good attempt. Very few candidates did not fill the page although very few were awarded the QWC mark for use of scientific language. There were only 3 technical terms that candidates needed to use to obtain the QWC mark but these proved out of reach to most. The level of detail in most of the candidate's responses was poor with very few candidates concentrating on the **roles** of zoos in conservation but describing **how** zoos conserve species. As this did not answer the question, it meant that many candidates wrote excellent pre-prepared answers but could not access many of the marking points.

Teaching tip

The following site, <http://www.paigntonzoo.org.uk/education/conservation-role-zoos.php> has some excellent information for teachers and students into the roles of zoos in the conservation of species. In addition to this, the following, <http://www.wwf.org.au/ourwork/industry/timber/> has some good information and useful links as to how forestry can be made more sustainable.

- Q.6 (a) Candidates found this question really difficult. Most candidates failed to give a suitable named example for an intensively farmed animal such as a chicken or a pig. Candidates also found it difficult to explain why yields were higher in intensive farming compared to those in extensive farming. The key answer to this question was that there is a greater yield per animal due to the controlled use of inputs and the efficiency this brings.
- (b) This question was easier for candidates to score higher marks with most describing how a deflected succession was caused as sheep selectively grazed the vegetation and damaged the area by trampling and adding nitrogenous waste.
- (c)(i) This question involved candidates reading the lead in statement carefully and using their knowledge of AS biochemistry to suggest how pollutants might attach to complex proteins. Very few candidates linked pollutant to possible attachment of amino acid R group, but most gave credible answers. Many candidates described possible links to hydrogen bonds or even the suggestion of linking to active sites of enzymes which are complex proteins.
- (c)(ii) Again, for this question, candidates needed to have linked the action of carcinogens to cellular activity and used their AS knowledge to describe the mutation of DNA leading to uncontrolled mitosis and possible cancer. Most candidates scored full marks for parts (c)(i) and (c)(ii).
- (d) The second long-answer question was not well done by many candidates and most showed a lack of understanding around the scientific issues of CFC and CO₂ release and the control and legislation of this release. Most of the responses from candidates lacked detail and too few discussed target setting by countries, help for LEDC's and the correct named agreement for the particular emission. This was a disappointing end to the paper as in the case of CO₂ this is a hugely topical and important subject and should be easily taught and understood in sufficient detail for A2.

Teaching tip

There is a good deal of information on intensive chicken farming at

http://www.channel4.com/food/on-tv/river-cottage/hughs-chicken-run/hugh-fearnley-whittingstall-talks-chicken-08-01-03_p_1.html which should stimulate debate and has links to video sections.

Also, the following site,

http://campaigns.direct.gov.uk/actonco2/home.html?qclid=Cl6_iOuv7pgCFUQI3wodJFC_0g&qclid=Cl6_iOuv7pgCFUQI3wodJFC_0g has lots of information and links looking into carbon trading and how governments and local communities can help tackle the problem of global climate change.

2805/04 Microbiology and Biotechnology

General Comments

All candidates were able to score marks on at least five out of the six questions, with question 5 proving to be the most difficult question, where some candidates were not able to gain any marks. There was a good range on all questions to allow discrimination to occur. As usual, a number of candidates had prepared well and were able to recall factual knowledge easily as well as make use of previous mark schemes to gain some very high overall marks. At the other extreme, some candidates appeared to have a command of the subject which was little above GCSE standard. The performance on questions 3 and 5 were markedly lower than other questions. Question 3 was plant related, a psychologically 'difficult' topic for many candidates, as well as containing synoptic material. Some of this should have been a fairly straightforward recall of information and candidates, as always, need continued prompting to think synoptically at A2. Two short questions, 4 and 5, were based on biotechnology in medicine. Question 4, which was generally well answered, relied more on factual recall. Question 5 had a synoptic element as well as a substantial requirement for candidates to apply their knowledge in an unfamiliar context. In addition, there was more text than usual to digest, which the majority appeared to find very challenging. There were quite a few instances where candidates lost marks by failing to check their answers, for example 'respire aerobically at first and then switch to aerobic respiration'; 'use lipase' instead of 'use ligase'. There was no evidence that candidates were under time pressure.

Teaching tip

When marking pieces of work set from exam questions, resist the attempt to correct or highlight all mistakes. Instead, write down the number of marks that were lost through careless error or lack or correct terminology and ask the student to check their work and use the mark scheme to be their own 'examiner'. Where students are willing, encourage them to swap work.

Comments on Individual Questions

Question No 1

This question was based on a theme of *Saccharomyces* and beer production. Candidates who could apply knowledge and understanding from a number of areas were well rewarded. Part (b) was the least well answered section, with only a few candidates gaining all five marks for this section.

- (a) In (i), nearly all candidates had a good knowledge of aseptic technique but many failed to include explanations and because of this limited themselves to a maximum of two out of the available three marks. As with previous questions on inoculation, a number of candidates forgot to give details of the actual transfer. Some candidates used up the entire stock broth culture by pouring it all into the flask, while others added culture to agar plates. The best answers gave clear descriptions of a transfer from the stock broth culture to the flask, citing the appropriate equipment and linking each step of the procedure with a valid explanation of the aseptic technique employed.
- (ii) required candidates to study carefully and use the information in Fig. 1.1 to consider modifications to design when scaling up and there were some detailed answers with explanations from stronger candidates. Despite almost identical representations of the filters, air inlet / mini-sparger and air outlet in stages 2 and 3, a number thought that these were only added at stage 3. In addition quite a few candidates thought that they could see a thermometer in stage 2.
- In (iii), most candidates were able to gain at least half the available marks and many gained all four, demonstrating a good understanding of the reasons behind each of the steps in haemocytometry. Incorrect reasons included: for agitation - the cells were well mixed with nutrients; for waiting five minutes - so cells could acclimatise to the surroundings. Accuracy

was not sufficient for the step where cells were counted within a triple-lined square: candidates were expected to realise that the systematic counting method avoided double-counting squares.

- (b) This included a synoptic element with respiration (Central Concepts) and many demonstrated a lack of knowledge in this area. A number of candidates had failed to read the instruction not to include details of the other stages of beer production and wasted time writing about these. It was also evident that a number were not sure where fermentation occurred and so wrote about the whole production process. There were however some excellent accounts. These included details of the initial aerobic phase of respiration that led to both an increase in yeast cell numbers as well as anaerobic conditions for the production of ethanol. Only a few candidates thought to include equations for respiration, although more stated the need for a named sugar as the respiratory substrate. Although the majority did give the link between anaerobic respiration and ethanol production, there were a surprising number who failed to mention ethanol (or alcohol) at all. Credit was given to naming the correct conditions for fermentation. Examiners accepted answers within a range of temperatures, 20 - 30°C, and pH 6.5 – 7.0.
- (c) This topic has been tested in one form or another on a number of occasions previously and was well-answered by the majority of candidates. A common error was to state that the inoculum / culture, rather than sterile nutrients, is / are added at a constant rate.

Question No 2

This question, designed to assess knowledge and understanding of features of microorganisms, included synoptic links from Cell Structure in Biology Foundation and Classification in Central Concepts. Those candidates who were able to glean knowledge from these areas were able to score well.

- (a) This was a straightforward exercise that should have gained high marks for most candidates, but there was only a minority that managed to score all five marks. Structure **A** and its function were correctly answered by almost all candidates, with **B** also well answered, although some candidates thought that it was SER or gave as its function as protein synthesis rather than modification. More detail than 'antigen' was required for structure **C**, with better responses correctly giving 'glycoprotein spike' and a handful naming the gp120 protein. A number of candidates incorrectly labelled **C** as 'receptor', which should be linked to the CD4 receptor of the host T-helper lymphocyte to which the protein of HIV binds. This was not penalised if the candidate correctly named 'protein'. **D** was not always answered by all candidates. 'Head' was accepted instead of 'capsid'. There were a surprising number of candidates who gave 'cell membrane' for the 'cell wall' of **E** and a few who thought that this was a middle lamella. Many correctly referred to the wall preventing osmotic lysis although credit was given where candidates described 'lysis' as 'bursting'.
- (b) Candidates were expected to place the organisms in size order by performing size conversions so that comparisons could be made. The whole mark range was seen, although over half were able to gain full marks. Those failing to gain any credit left the column blank, or totally misinterpreted the question and tried to calculate magnifications, or got the order totally the wrong way round. Most however were able to score one mark by correctly placing *Chlamydomonas* as the largest microorganism. There was some evidence that a number of candidates had no idea how to perform the calculations and completed the column by reasoned guesswork alone.
- (c) In (i), many candidates incorrectly identified the kingdom to which *Chlamydomonas* belonged as 'Eukaryote', rather than 'Protoctista'. The features of protoctists in (ii) were mainly confined to descriptions of eukaryotic features, which only gained 1 mark.

Candidates generally were unable to broaden their descriptions to the other available mark points.

- (d) This required candidates to extend their knowledge of learning outcome (d) from 5.8.1 to consider also the genetic material of fungi. All that was required here was to recognise that fungi are eukaryotic. A handful of candidates gained maximum marks by giving sufficient detail and breadth of information and these tended to produce well-written accounts. It was expected that many candidates would write about the circular DNA of bacteria versus the linear of fungi (and also of lambda), but this was not the case. Marks were also lost by a lack of care, for example, by stating that a bacterium had a circular 'strand' of DNA, or by stating that *lambda* had RNA with reverse transcriptase (confusion with HIV) or had RNA or DNA, but never both (confusion with a general feature of viruses). Better answers correctly noted the lack or presence of histone proteins as well as the presence of plasmids in some bacteria.

Teaching tip

The insert for Question 2 could be used as an independent research assignment: tippex the sizes printed on the insert and then get students to (i) find out the actual sizes of the microorganism (ii) perform a range of conversion calculations to get the actual size in nm, μm , mm, cm (iii) work out the magnifications of the images on the insert

Question No 3

Plant tissue culture questions have often produced a wide range of marks and many candidates appear to find the topic difficult. As plant tissue culture techniques are used in the genetic improvement of crop plants, some candidates confuse the two. In the extended answer of part (c), this was the case for some candidates.

- (a) This was poorly answered by many candidates, who were not able to cope with the strong synoptic element. In (i), candidates were allowed to choose two out of the five mineral ions and a number took the opportunity to answer correctly on the two elements of which they were most confident. Phosphorus and sulphur were the most popular choices of stronger candidates. However, there were many who wrote 'important in growth' for both elements. Magnesium used in chloroplast structure was not considered sufficient for chlorophyll structure. The majority gained a mark for a correct reference to energy in (ii), but very few gained the second available mark. Sugar providing carbon needed to be explained, i.e. for the synthesis of organic molecules, or a named molecule, before a mark was awarded. Weaker responses cited the need for sugar for photosynthesis. A minority of answers recognised that fact that the sugar was only required initially, before photosynthesis began. In (iii) many gave the correct response, but there were quite a few blanks as well. 'Growth factors' was a common incorrect response. In (iv), many candidates read 'root' and thought that it was the ability to take up water and mineral ions that made root tips successful in plant tissue culture techniques - only a few linked root tips to meristematic growth and gave a correct response.
- (b) This proved to be very demanding for candidates. Air flow hoods are commonly used in plant tissue culture techniques and many candidates showed an understanding of their benefits in preventing contamination of the culture, but far fewer gave a solid account of the main features of an air flow hood. The importance of high efficiency particulate air (HEPA) filters was noted by some candidates, but the majority of answers simply wrote about 'filters', without realising that these would not provide the desired sterile air for the unit. Common misconceptions were that the flow hood provided a supply of oxygen for respiration or carbon dioxide for photosynthesis. There was also confusion in understanding that, in this case, prevention of contamination of the culture was required, so

air should be moving away from the work area and into the external environment. Some accounts gave details of *preventing* air from moving out to avoid contamination of the external atmosphere.

- (c) Many candidates scored for part (c), but some were lacking in clarity and only gained the mark with a 'benefit of doubt' decision.
- (d) Fluent accounts from better candidates, with good use of technical terms and sequential descriptions, gained more than the maximum mark points and a well-deserved QWC (quality of written communication) mark. However, most candidates seemed to want to write about protoplasts, despite being given the stimulus diagrams in Fig. 3.1, and just went ahead to give details about the use of enzymes and mannitol solution to obtain protoplasts. Where they continued to describe callus culture formation and the events from then on, many were able to begin to pick up marks. Many thought that the bleach solution removed the cell walls. Others got very confused with details, for example, thinking that the explant removed was a strip of epidermis or the covered container for the plantlets was an air flow hood. Examiners generally had to pick their way through non-sequential and quite muddled accounts to try and award marks. Correct annotations on Fig. 3.1 were credited. The full range of marks was seen, with a number demonstrating a total lack of revision on this topic by leaving the page blank. The QWC was not often awarded.

Teaching tip

Students should be encouraged to carry out internet image searches for the many different topics that they come across in the specification for this option, for example, items such as air flow hoods (laminar flow cabinets), biogas digesters, activated sludge digesters are obviously not available to observe from the classroom but are much more easily understood if students have a visual memory of them

Question No 4

Most candidates found this an approachable question, with a number gaining almost full marks. For weaker candidates, the final mark awarded did not always reflect the quantity written.

- (a) Although this was a stated learning outcome in the specification, many candidates did not understand what to do here and only gave descriptions of the genetic manipulation of *E. coli*. Where possible, Examiners could give this credit for the fact that microorganisms could be easily genetically manipulated. Weaker responses were contrasted by some excellent accounts from candidates who were on familiar ground and readily able to gain all the available marks. Compared to similar responses in previous sessions, there was a clearer distinction between avoiding (immune response) side effects compared to avoiding disease from infectious agents.
- (b) This was very well attempted by many candidates, with stronger candidates coping well and gaining all the available marks. At the other end, weaker responses left one or more boxes blank or gave answers that were too brief or out of context. The first column, headed '*description*' required candidates to give more than 'plasmid' and 'ligase' in the relevant boxes. Where this occurred, candidates were penalised once. The explanations for 'mixing vector and gene' and 'screen for successfully transformed cells' were well provided by those candidates who paid attention to detail. Poorer responses tended to re-write the description for these.

Question No 5

This was set as the most demanding question of the paper and it performed as expected, with only the exceptionally strong candidates gaining nearly full or full marks. The fairly significant amount of reading required, similar to that in questions in the Unifying Concepts paper, proved to be quite daunting for some candidates.

- (a) (i) was correctly answered by the majority of candidates, although some thought, incorrectly, that they could gain the mark by stating that the implantable glucose biosensor was portable as it was inside the body. In (ii), it was hoped that if candidates did not consider the unreliable performance of the biosensor if enzyme leached out, they would be prompted by the information given that the source of glucose oxidase was a fungus, to consider the immune response implications of the enzyme acting as a foreign antigen. These mark points were seen far fewer than numerous answers suggesting what would happen if the glucose oxidase appeared in the body. There were some very dramatic suggestions where no consideration was given by the candidate to the volumes of enzyme involved. These included comments such as 'would remove oxygen so cells won't be able to respire, leading to death', 'would produce hydrogen peroxide / gluconic acid, which are dangerous and would kill'. The ideas suggested were considered carefully by the Examiners and where correct biology was stated, credit was given.
- (b) This rarely scored more than one mark. Most candidates forgot the features of an immune response and stated that there would be an immediate rejection of the mouse antibodies. Hardly any candidates realised that the antibodies would (i) appear effective at the first attempt because of the time elapsed in the primary immune response to sensitise and clone specific lymphocytes and (ii) only appear problematic on subsequent attempts at treatment. Some candidates thought that the treatment involved mouse cells rather than antibody.
- (c) In (i), most answered from the point of view of chemotherapy. Many understood that chemotherapy treatment produces unpleasant side effects, but fewer showed an understanding that this was because their effect on healthy non-tumour cells. Examiners did credit a correct reference to side effects. Stronger candidates answered the question directly, citing the specificity of Trastuzumab to tumour cells only. Many answers to (ii) were too general to gain the mark, for example 'it doesn't work on other tumours'.
- (d) This was an example where a number of candidates probably did know the answer, but failed to give sufficient details to gain the mark. Few candidates stated the obvious: that antibodies are proteins. Many simply stated that mammalian cells should be used as they had ER / Golgi bodies, but did not go on to link this with the ability to glycosylate the antibodies. Weaker candidates missed the point entirely and chose to use *E. coli* as they thought that this would lead to higher antibody yield.

Question No 6

This was an accessible question to complete the paper and for some of the weaker and mid-range candidates this provided them with their highest mark. It was particularly pleasing to see some of these candidates make very good attempts to tackle part (b), which included a 'comment' command term in the question.

- (a) This was the more popular and less challenging extended answer for most candidates and it produced some very impressive accounts. Unfortunately a few of the stronger candidates misinterpreted the question and wrote about the advantages of immobilised enzymes compared to immobilised whole cells. However, they were still able to pick up some of mark points. References to reduced costs and higher yields were usually well linked to relevant points. The best answers avoided repetition and introduced advantages that

seemed to lead naturally to the next. A good definition of immobilised enzyme was considered worthy of a mark and many candidates began their answer with this. The most common advantages stated, apart from cost and yield, were re-use, reduced contamination, easier downstream processing and increased stability to extremes.

- (b) There were some very varied marks, with some of the better candidates failing to give sufficient detail to gain maximum marks or tending to give answers that relied heavily on theory, while weaker and mid-range candidates sometimes picking up more points by commenting on the data provided. The fact that the figures were not provided on gridded backgrounds meant that Examiners were lenient when candidates provided estimated values. There were more attempts than usual to quote comparative values, although there was still plenty of room to give further data to supplement a description. In Fig. 6.1, it was unusual to find a script where a candidate had noticed that the two time course curves were very similar. Having just answered a question that concentrated on the advantages of immobilised enzymes, many were reluctant to state that, in Fig. 6.2 and for some pH values in Fig. 6.3, the enzyme free in solution performed better than when immobilised. Some candidates did not realise that it was the same enzyme that was immobilised in each case.

2805/05 Mammalian Physiology and Behaviour

General Comments

The paper was of appropriate difficulty and was comparable to papers of previous sessions. There were no obvious misinterpretation of the rubric and candidates were able to complete the paper in the time available with most attempting all sections. Candidates were provided with stimulus material where appropriate, to assist them in forming their responses. There was a good balance between interpretation, recall, manipulation of data and application of knowledge to new situations, addressing all the assessment criteria in the specification.

Again a sizeable minority of candidates has very poor handwriting and centres should be encouraged to apply for the use of a laptop in the examination where a candidate is in danger of losing marks if his/her handwriting cannot be deciphered.

The overall performance of the candidates seems to be in line with the performance in previous years, with a relatively normal distribution of marks. There was certainly a wide range of ability and attainment.

Comments on Individual Questions

Q.1 This question combined synoptic material, interpretation of graphical data and recall. Most candidates were able to gain marks fairly easily in each section.

- (a) Figure 1.1 showed a diagram of the human digestive system and candidates were asked to state the main location of the activities listed in the table using the letters provided in the figure. Although this section was designed to be an easy introduction to the paper, surprisingly few candidates managed to achieve full marks. The identification of the main location of the digestion by lipase and amylase proved to be the most problematic, whereas most understood where the absorption of glucose and inorganic ions would take place.
- (b) In Figure 1.2, candidates were provided with a diagram of part of a molecule of porcine pancreatic polypeptide (PP). It was anticipated that candidates would refer to the structure illustrated in their response. In general, candidates understood that the polypeptide would have primary, secondary and tertiary structure although some did not supply any further detail so failed to gain a mark. Nevertheless, good candidates described the primary structure as the sequence or order of amino acids and recognised that this was coiled to form areas of alpha helix. Many also added that the secondary structure was folded to achieve a tertiary structure. There was frequent mention of at least one type of bond that would be found in the polypeptide in the correct context, however few commented on the globular nature of the protein.
- (c) The majority of candidates were able to describe the effect of pancreatic polypeptide infusion on the secretion of hydrogen carbonate ions as shown in Figure 1.3. Most appreciated that PP would reduce the secretion of either pancreatic juice or hydrogen carbonate ions in the first 80 minutes; frequently giving paired figures to support their answer. Many also commented that the secretion then rose after 80 minutes. Fewer candidates offered an explanation as to why this might happen, although some stated that PP would inhibit either hydrogen carbonate secretion or secretin. There were also a number of correct references to the action of secretin.

- (d) In this section, candidates were required to apply their knowledge of cancer, which produces malignant tumours, to explain the meaning of non-malignant. Most understood that a benign tumour was not cancerous and therefore would not spread, although they occasionally neglected to qualify their answer by stating that other tissues or organs of the body would not develop secondary tumours. Good candidates also added that these tumours would not metastasise however hardly any commented on the fact that the tumour would still compress the surrounding tissue.
- (e) In general, candidates were able to achieve this mark for suggesting that PP could be used for weight loss in obese or overweight people by suppressing appetite.
- Q.2 (a) (i) Almost all candidates were able to achieve both marks for accurate descriptions of the effect of an insulin injection on the blood glucose concentration of a dog. Most appreciated that the contraction fell after the injection and subsequently rose after six hours and many supported these statements by using paired figures from the graph.
- (ii) In this section candidates were asked to suggest reasons why diabetic dogs have a tendency to drink a lot of water and lose body mass. Good candidates began their response by explaining that these dogs would not be able to secrete insulin, which was then linked to an inability to convert glucose into glycogen so that blood glucose would remain high. Some continued to state that the water potential or solute potential of the blood would be reduced resulting in water moving into the blood by osmosis from cells and tissues. Although many also understood that this would lead to dehydration, there were comparatively few references to feelings of thirst and hardly any mention of the detection of a low water potential by the osmoreceptors in the hypothalamus. A number commented that glucose would be lost in the urine, necessitating the use of fat and protein as respiratory substrates thereby accounting for the loss in body mass. Weaker candidates suggested that water would be required for hydrolysis reactions and high blood glucose would suppress appetite. Only rarely were full marks awarded for this question and some candidates failed to score at all.
- (b) (i)(ii) Many candidates were able to name correctly, using the list provided, both the vessel that transports insulin to the liver and the vessel with the highest concentration of urea.

- (c) The first extended response required candidates to explain the role of the liver in adjusting any variations in the blood glucose concentration. While better candidates offered a good description of the processes involved, comparatively few managed to achieve full marks. Many appreciated that high blood glucose would result in insulin secretion, although insulin binding to receptors on the membrane of the hepatocytes was frequently omitted. Nevertheless, its action on liver metabolism was well-understood by good candidates, who stated that it would increase the permeability of the membrane to glucose and promote its uptake by the hepatocyte. Although the majority of candidates commented that glucose would then be converted to glycogen for storage, there were few references to the increased use of glucose in respiration or its conversion to lipid.
- On the whole, the action of glucagon on the hepatocytes was described in more detail. Most candidates stated that it would promote the hydrolysis of glycogen back to glucose to increase blood glucose concentration. Many then continued to explain the process of gluconeogenesis from non-carbohydrate sources and while some falsely believed that fatty acids could be converted to glucose via the Krebs' cycle, better candidates provided good detail of the biochemical pathways necessary for the synthesis of glucose from amino acids, glycerol or lactate. Some also mentioned the action of adrenaline in promoting these pathways though references to glucagon activating enzymes were rare.
- Weaker candidates often concentrated on the detection of blood glucose concentration by the endocrine cells of the pancreas while neglecting the role of the liver. Often only two marks were gained simply for stating that low blood glucose would stimulate glycogenolysis whereas high blood glucose would stimulate glycogenesis. Others made the mistake of describing the metabolism of glucose by muscle cells, which did not attract any credit.
- Surprisingly few candidates mentioned homeostasis in their response although there were some references to negative feedback.
- The QWC mark for this section was awarded for a clear, organised response using specialist terms and many candidates were able to achieve this mark although weaker ones failed to gain it either because of a confused account or more commonly a lack of (or mis-spelt) technical terms.

Q.3 This was a straightforward question which allowed most candidates to accrue marks fairly easily.

- (a) Candidates were provided with side view illustrations of a human and rat brain and were asked first to name structure X and then describe the differences in this structure between the two mammalian brains. The majority were able to identify X as the cerebrum or cerebral hemisphere, some even naming the lobe as either parietal or occipital. Weaker candidates believed structure X to be the cerebellum. Many commented that the human had a larger surface area but although they also recognised that it was highly folded, they neglected to make a comparative statement. Good candidates also appreciated that the human cerebrum constituted a larger proportion of the whole brain than that of the rat. Some made the mistake of describing differences in the functions of the two brains rather than the structure, stating that the human brain would involve more complex, higher order processing and thus would contain a greater number of neurones.
- (b) Most candidates recognised structure Y as the cerebellum and were therefore able to suggest the symptoms that would be displayed by dogs with a disorder of this structure. Many stated that dogs would have poor co-ordination of muscle movement as well as impaired posture and balance or gave descriptions, such as clumsiness or falling over. However, those candidates who had identified structure Y incorrectly were unable to offer acceptable symptoms.

- (c) Again, those candidates who were not able to identify structure Z as the medulla oblongata could not give two suitable functions. Some thought it to be the hypothalamus, going on to describe its role in the control of the pituitary. Better candidates stated that it would control heart rate and breathing rate, although correct references to the control of peristalsis and blood pressure were also seen.
- (d) In Table 3.1, candidates were presented with data on the relationship between brain mass and body mass in five mammals and were asked to calculate the ratio between brain and body mass for the porpoise and rat. Most completed the calculation correctly, although some made the mistake of not giving their answer to the correct number of significant figures for the porpoise. As the ratio for the rat was a whole number, the error, if repeated, was ignored and credit was given. Only rarely did candidates fail to score any marks on this section.
- (e) This section proved to be the most problematic of the whole question. Candidates were given information as to why some children are unable to experience pain due to the lack of an allele of a gene required to produce voltage-gated sodium channel proteins in sensory neurones that form synapses with pain receptors. They were then required to suggest why this condition would prevent these children from experiencing pain. Many candidates failed to grasp that the pain receptor would function normally and release neurotransmitter in response to stimulation but that there would be no receptor on the postsynaptic membrane of the sensory neurone to which the neurotransmitter could bind. Consequently, their responses frequently stated that the sensory neurone would be unable to stimulate the pain receptor because no neurotransmitter could be released and that no depolarisation of the pain receptor would be achieved. However, better candidates gained a mark for understanding that there would be no depolarisation of the sensory neurone, so that no action potentials would be transmitted to the brain, although hardly any mentioned that the pain areas of the brain would not be stimulated.
- Q.4 This question largely concentrated on recall but nevertheless was a good discriminator. Candidates who had learned the material well were able to achieve good scores on sections (a) and (c) and apply their knowledge to section (b).
- (a) (i) Figure 4.1 showed a diagram of a mammalian neuromuscular junction and candidates were asked to identify a Z line of a sarcomere. Many candidates were able to label this correctly although some indicated an M line.
- (ii) There were many excellent descriptions of how an action potential arriving at the neuromuscular junction could result in the depolarisation of the sarcolemma. Many candidates understood that the arrival of the action potential would open calcium channels, allowing the influx of calcium ions although some neglected to mention that this would occur at the presynaptic knob. Nevertheless, most carried on to explain that the entry of calcium ions would stimulate the movement of vesicles containing neurotransmitter towards the presynaptic membrane causing fusion and the release of acetylcholine into the synaptic cleft by exocytosis. However, some suggested that calcium ions would cause the synthesis of either the neurotransmitter or the vesicles, and that the vesicles themselves would enter the cleft. Good candidates described the diffusion of the neurotransmitter across the cleft and its binding to receptors on the sarcolemma, resulting in the opening of sodium channels. References to sodium/potassium channels, or activation of the sodium-potassium pump were not credited. Although many commented that there would be an influx of sodium ions, most failed to qualify their statement, by adding that the ions would enter either the muscle fibre or the sarcoplasm.

(b) In this section, candidates were told that the venom of the Banded Krait, *Bungarus multicinctus*, acts at the neuromuscular junction to cause muscle paralysis and were asked to suggest how the active component, bungarotoxin, might act. There were a number of ways in which candidates could approach this question and credit was given to any reasonable response. Many appreciated that the toxin could bind to the receptors in the sarcolemma, thereby competing with, or blocking, the neurotransmitter thus preventing depolarisation. Some suggested that it might interfere with the release of the neurotransmitter from the presynaptic membrane by preventing the uptake of calcium ions at the motor end plate thereby inhibiting exocytosis. Others commented that the toxin may inhibit the action of acetylcholinesterase resulting in continuous stimulation of the sarcolemma as acetylcholine would remain in the synaptic cleft. Weaker candidates gave descriptions as to how mechanisms within the muscle fibre itself would be impaired and therefore gained no credit.

(c) The second extended response required candidates to describe the structure and arrangement of the proteins in a sarcomere that are responsible for muscle contraction. Some misread the question and gave an account of the mechanisms involved in muscle contraction, but were still able to gain credit for structural detail of the proteins involved. On the whole, only better candidates were able to achieve the full marks available for this section, with weaker ones generally scoring fewer than three.

Most candidates commenced by naming the actin and myosin filaments present in the sarcomere and continued to state that the actin filament is composed of actin, troponin and tropomyosin. Better candidates commented that both actin and troponin are globular proteins and provided detail as to the arrangement of the three proteins in the thin filament. Some understood that the actin molecules form long chains and that there are two such chains twisted around each other, with tropomyosin being located within the resultant groove. Many also appreciated that tropomyosin conceals the myosin binding sites on the actin filaments or alternatively, stated that tropomyosin could be removed to reveal these sites during muscle contraction, thereby allowing the binding of the myosin heads. However, there were relatively few references to the attachment of troponin to tropomyosin. Some candidates understood that myosin is a fibrous protein with globular heads, while others correctly stated that the head consists of a molecule of ATPase. Many candidates attempted to describe the composition of the various bands in a sarcomere, such as the A and I bands and the H zone, although a number of descriptions were either confused or inaccurate. While some commented on the position of the M and Z lines, few recognised that myosin and actin tails, respectively, are anchored in these lines. Nevertheless, the majority of candidates understood that there is an overlap of the myosin and actin filaments.

The QWC mark for this response was for legible text with accurate spelling, punctuation and grammar and most candidates were awarded this mark for reasonable prose of sufficient length.

Q.5 This question allowed most candidates to score reasonably well. Sections (a), (b) and (e) involved recall from the specification, while (c) was synoptic and (d) required extrapolation from information provided in (a).

(a) Fig. 5.1 showed a computer-assisted drawing of a small part of the human retina. Candidates were asked to name the cells labelled L, M and N. Most candidates were able to identify the cells L and M as ganglion and bipolar, respectively, although some believed cell N to be cone cells, rather than rods.

- (b) The stem of the question gave a description of the disease *Retinitis pigmentosa* (RP) that affects the rod cells (N), and then required candidates to describe the symptoms of loss of vision that may be experienced in the early stages of the disease as these cells degenerate. Many candidates appreciated that the person would suffer a loss of night vision, or the ability to see in low light conditions, although statements concerning loss of vision in the dark were not credited. Better candidates also understood that a degeneration of the rod cells would lead to the impairment of peripheral vision. Where candidates had incorrectly named cell N as a cone cell, an error carried forward was allowed, so marks were awarded for comments that visual acuity would be compromised or alternatively, that vision may be blurred, and that there may be a loss of colour vision.
- (c) The different patterns of inheritance of RP were listed and candidates had to complete a table indicating the likely inheritance pattern for the type of family history described. Most candidates understood that where the disease was only present in male family members, it would be X-linked recessive, whereas if present in one parent, it would be autosomal dominant. If not present in the last three generations, many candidates were able to identify the disease as autosomal recessive.
- (d) A method used to enable some people with RP to perceive images was described. It involves the fitting of an artificial retina consisting of a miniature camera attached to a pair of dark glasses. The camera sends a signal to a silicon chip attached to the retina by means of electrodes which then stimulate cells in the retina. Candidates were asked to use their knowledge of the retina and relate it to Fig. 5.1 in order to suggest which cells that would be stimulated by the electrodes, giving an explanation for their choice. Many candidates were able to suggest at least one of the possible three cells (cones, bipolar or ganglion cells) which could be stimulated but generally failed to offer a satisfactory explanation. It was anticipated that they would comment on the fact that none of these cells would have degenerated as a result of the disease, and therefore would still be fully functional, but many simply described the mechanisms involved in depolarisation or the pathway that an action potential would take in order to reach the brain. Some suggested that the rod cells (although degenerated) would be stimulated as the dark glasses would only let through light of low intensity.
- (e) This section commenced with a photograph of a cataract. The most frequent reason given for this condition was the denaturation of proteins in the lens. Many candidates went on to offer further detail, such as this would cause a change in the tertiary structure of the proteins, resulting in their clumping or coagulation. Few made reference to the lens consisting of living cells or that these cells would have a reduced oxygen supply. However, some understood that cataracts could be caused by degenerative disease or the action of UV light.
- (f) The majority of candidates provided comprehensive descriptions as to the most effective treatment for cataracts, easily achieving the maximum marks for this section. Almost all of them stated that the lens, or cataract, could be removed and replaced by an artificial one. Many also described the techniques that could be used. Most candidates ended their response that glasses would have to be worn as the artificial lens would not be able to change shape to converge light rays.

Q.6 This was a short, straightforward question to end the paper and most candidates were able to score marks fairly easily, especially for section (b).

- (a) Figs. 6.1 and 6.2 were drawings based upon photographs taken by Wolfgang Köhler while studying learning behaviour in chimpanzees. The question required candidates to describe and explain the learning processes illustrated. Most candidates recognised that the behaviour exhibited by the chimp was insight learning, usually adding that it had stacked up the crates in order to climb up and reach the banana. Many commented that the chimp would initially play with the crates before working out, through trial and error, that they could be used to increase its height. Better candidates also referred to the use of previous experiences to solve problems. Weaker ones described the behaviour as operant conditioning and some believed that two chimps were involved in the study, one copying the actions of the other to gain the banana.
- (b) Most candidates were able to describe what is meant by a reflex action although some neglected to explain its advantage in survival or minimising damage. Responses frequently stated that the action would be rapid and automatic, involving neither the brain nor conscious thought, but references to unconscious actions were not credited. Most candidates appreciated that the response would also be innate or equivalent, and sometimes described the pathway the reflex would take. Better candidates also mentioned that reflexes were not learned and could be conditioned.
- (c) Candidates were presented with three different situations and asked to state for each whether operant or classical conditioning had taken place as well as giving a reason for their choice. The majority of candidates understood that a dog never jumping on furniture in the presence of its owner was an example of operant conditioning as it would receive negative reinforcement by being punished for its actions. In the second situation, although candidates recognised that, after surviving a serious car accident, the increase in a woman's pulse rate upon hearing screeching brakes would be due to classical conditioning, some confused unconditioned and conditioned stimuli and responses, though better candidates commented on the association of the sound of the brakes with the accident. In the last situation, where sheep run to an empty food container when they hear a tractor engine, a surprising number of candidates believed this to be another example of classical conditioning. Nevertheless, many appreciated that this was operant conditioning due to positive reinforcement as sheep ran to the container in anticipation of the reward of food after learning to associate the engine noise with its arrival.

2806/01 Unifying Concepts in Biology - Written Paper

General Comments

The four question format again suited candidates, giving them plenty of time to process the information given and to complete the paper. Good candidates were able to score close to full marks and even weaker candidates were able to access some marks on all four questions.

Comments on Individual Questions

- Q.1 While the biochemistry at the start may have seemed tough, most candidates scored better on parts (a) and (b) than in the calculation and interpretation parts on the second page of the question.
- (a) Well-answered in general but few managed to score all 5 points. Erroneous answers included identifying beta glucose rather than alpha (or failing to specify alpha) and thinking starch is soluble. The storage organelle mark was least frequently achieved.
 - (b) Many candidates gave excellent answers and were clearly very familiar with the Calvin cycle. A few knew the diagram but could not express the ideas in words, stating for example that GP combines with ATP, or that ATP is used to phosphorylate GP, rather than that ATP is used as an energy source at this stage. The role of reduced NADP was also poorly described by many. Candidates should avoid phrases like "TP goes to glucose" and should seek to understand what is meant by the arrows on the Calvin cycle diagram. A few weaker candidates confused Krebs cycle with the Calvin cycle.
 - (c)(i) Few candidates scored this mark. The vague answer "genes are altered" was not credited. Candidates should be taught that genetic modification involves the addition or insertion of a new, extra piece of DNA into an organism, and that it is not a catch-all term for any process of changing the genotype. Some candidates, for example, referred to selective breeding in their answers, showing the extent of their misunderstanding. Candidates should also be made aware that while extra DNA can be inserted, it cannot be removed from a living organism. RNA interference can switch off genes, but this was beyond the scope of this question.

- (c)(ii) Fewer than half the candidates could calculate the percentage difference. Those who went wrong either did not perform the subtraction (find the difference) before proceeding to a percentage calculation, or did not divide by the wild type baseline figure of 2.9 to find the improvement.
- (c)(iii) Better candidates scored a mark here, few obtained both marks. Many described what dry mass is but did not explain the significance of measuring this.
- (d) A great many very confused answers were given to this. Some thought ponies ate tobacco, others suggested ponies ate nutrients in soil, including fructans from the soil. Those who grasped the central idea often failed to score the “adapted to” mark by using poor terminology such as that the ponies were not used to, resistant to or immune to the high levels of fructans.

Teaching tip

In teaching metabolic pathways, candidates should practice describing the stages as well as learning them through diagrams, as they may know the diagrammatic outline but be unable to explain what is actually happening at each stage.

Q.2 A significant number of well-prepared candidates were able to score full marks or close to full marks on this question, showing a good working knowledge of classification and of events at the synapse.

- (a) While many candidates did fill in all five boxes correctly, candidates’ success often seemed to be centre-dependent. Spelling in general was poor, particularly of the kingdom names. The prokaryote was frequently misidentified as a protist and a surprising number of candidates could not assign the mollusc to its correct kingdom.
- (b) Many answers to this were a joy to read and mark. Candidates really understood the process of transmission of a nerve impulse across the synapse, and were able to intelligently integrate the information on neurotoxins into their answer. Key facts were presented clearly, logically and sequentially. Marks were lost however when candidates failed to talk about IONS of calcium and sodium, stated that ions moved or diffused INTO a membrane, or simply lifted information from table 2.2 without applying or integrating it into their answer. Less common errors were confusing acetylcholine with acetylcholinesterase or with sodium ions, or referring to Ach as a hormone or enzyme.

Teaching tip

Classification often presents problems for students and is something that can profitably be revisited when referring to organisms that appear in other areas of the syllabus. Candidates should be encouraged to actively learn the spellings of unfamiliar names such as those encountered in taxonomy.

Q.3 Candidates scored well on this question and were able to show off skills related to data handling and interpretation and knowledge of coronary heart disease.

- (a)(i) The vast majority of candidates gained the mark here.
- (a)(ii) The negative correlation was correctly described in most cases but not all candidates scored the mark for quoting figures in support. As usual, some attempted to do this but missed off the units and so lost the mark. Some also misunderstood the y axis units, and quoted 80 000 000 men rather than 80 per 100 000 men, etc.
- (a)(iii) Most correctly identified USA either from its distance from the line of best fit or from knowledge of American diet and lifestyle.
- (b) Candidates who successfully interpreted the information given and managed to draw a fatty acid of any description gained the full two marks. In general however there were many errors. Virtually no scripts showed more than one double bond present in the molecule, suggesting that candidates somewhat surprisingly do not know or did not register the meaning of polyunsaturated. Few drew a double bond in the omega position as described to them. A great many A2 Biology candidates do not understand that carbon has a valency of 4, oxygen 2 and hydrogen 1 and the answers seen were riddled with errors, with these key elements forming too many bonds.
- (c)(i) In this question students often scored one of the two points, but rarely considered both. Most correctly identified the capsules as the better method.
- (c ii) Here most candidates scored both marks, for predicting that higher omega-3 fatty acid intake will decrease blood pressure and slow the speed of blood clotting. Candidates needed to refer to the speed of clotting, and not just say it becomes harder, or that clotting "is lowered". They need to take care when describing increased or decreased speed to use language accurately. For instance, speed is reduced means that time taken is greater.
- (d) Many good answers were seen, with candidates homing in on aspects of poor diet, lack of exercise, smoking and increased alcohol consumption.
- (e)(i) Most candidates had studied the information given carefully enough to have spotted that the two sets of data were taken in different years. Some also noted the difference between men only being counted in Fig. 3.1 and both sexes in Fig. 3.2.
- (e)(ii) This was the part of the question that was poorly answered and which tested candidate's capabilities to the utmost. It required very careful reading of the question, and careful teasing out of what information was relevant and what not. The hypothesis they were asked to evaluate was the suggestion presented in part (d) that the lifestyle of a patient with depression might put him or her more at risk of developing cardiovascular disease. The relevant features of this lifestyle, as identified by most candidates, were poor diet, lack of exercise, smoking and increased drinking. In the light of the data in Fig. 3.2 it was expected that candidates would question this hypothesis, and recognise that the correlation between heart disease and depression might be because both are causally related to omega-3 fatty acid intake in fish instead. The majority of candidates either evaluated a different hypothesis (e.g. that cardiovascular disease and depression are correlated, which they have already been told is the case) or evaluated Fig 3.2 alone, or took fish intake to be a part of lifestyle, evaluating the relationship between cardiovascular disease and lifestyle, rather than with the lifestyle of a patient with depression.

Teaching tip

As ever, candidates should be encouraged to read the question very carefully and to be clear as to what they are being asked to do and what not. They should also learn to look at the number of marks awarded for each part of a question, and if they can see they have answered with one reason where more marks are available, to come up with additional reasons e.g. part (c)(i).

Q.4 To score well on an ecology question like this, students really need to learn the technical terms for ecological principles and to be able to apply them. Too many answers were vague and the level of knowledge of wild plants and animals shown was surprisingly low.

- (a) Generally well done.
- (a)(ii) Wrong answers included nitrification and denitrification, but most candidates stated eutrophication, although many couldn't spell it.
- (a)(iii) Surprisingly poorly done. Many answers did not name a type of organism at all, or did not state how the abundance would change. Candidates should be very wary of using the word "affect" as in "It will affect the numbers of fish present..." since here they are not telling us *how* the abundance is affected, i.e. whether it increases or decreases. Candidates were penalised if their explanation involved incorrect reasoning, and the old error that increased algae reduces oxygen levels in the water crept in here. A misunderstanding of a coppice growth pattern became apparent in answers where it was stated that the number of willow or aspen trees would decrease since the beavers had cut them down.
- (b)(i) Many candidates scored two marks (omitting enough detail for the third mark) but many also attempted to explain that ice can act as a barrier to block access to beavers by predators but could not pin down the physical property that was important. This was not just that water freezes (since any substance freezes at the right temperature) but that ice when it freezes is less dense than water. An explanation of why this is so, describing the formation of the maximum number of hydrogen bonds spacing the molecules out in a regular lattice, would have earned the third mark point.
- (b)(ii) Many earned one or two marks, but plenty of candidates went off on a wrong tangent stating that the xylem only contains water and that beavers don't need this because they live in a pond.
- (c) Wrong answers included evolution, rotational coppicing and sustainable forestry.

Teaching tip

Candidates should learn to question whether they have answered the question or stated a relationship if they find themselves using the term "affects".

2806/03 Practical Examination

General Comments

This Practical Examination had a slightly different structure from previous sessions. In Question 1 of the investigation, candidates were not required to draw a graph but were asked to give both a description and explanation of their results. Half the marks were for description and candidates were given a lot of information in the stem of Question 1 to help them formulate their explanations. Candidates could also access half the marks for this section by applying their AS knowledge of enzyme activity. In some Centres, candidates had perhaps been encouraged to expect an intermediate result for test tube B and “adjusted” results to fit the misconceived idea that starch is produced slowly. The section following recording of results and explanation of findings has usually been on validity or reliability of procedures. In this session, the next question asked candidates to describe a way to modify the procedure to obtain quantitative results. A large number of candidates described improvements or criticisms of their procedure in line with the previous format. These candidates unreflectively reproduced the information required at this stage in past papers usually gaining no marks at all in this section.

Teaching tip

Discourage candidates from applying previous mark schemes to questions without due care and caution. Questions can be subtly or not so subtly different in wording and approach. Cut and paste past papers to change the order of questions to break the routine and sequence of answers. Hopefully candidates will be alerted to the need to examine each question stem for exactly what form of response is required as a matter of habit.

A very high standard was achieved in the second part of the Test, Q.2, using the slide. A large number of candidates scored full marks for Q.2. A good synoptic knowledge of meiosis from Central Concepts was demonstrated. However, as noted in the past, candidates often described structures not visible and drew textbook diagrams of prophase rather than what they could genuinely see. Candidates gave full answers in all sections of the Test and there were no indications of problems due to lack of time. An excellent performance was also seen in Plans with many candidates gaining the full sixteen marks. Again, candidates applied their A and AS level knowledge of competition and population growth very well. Examiners noted that in the Plan, the trend of importation of material from the Internet continues. This was often done with little consideration of its relevance and sometimes coherent meaning within the candidate’s text. Candidates presented methods and results tables from secondary sources without distinction from their own ideas and results. The need to reference and acknowledge information from other sources must be emphasised.

Comments on Individual Questions:

Q.1 Table: Candidates found difficulty in designing a table to fit all the headings and results they wished to record. Few solved the problem of how to neatly include a lot of information into a table. As a solution some ingenious compound headings and keys were used. Unfortunately Candidates did not always include their initial observations, at time zero in their tables and lost the mark for recording the correct times. Including contents of test tubes in the table was centre-based and it was clear some candidates had been taught to always do this. Colour change or observation was usually included as a column heading, but the heading time was often missed out. Nearly all candidates observed and recorded the correct trend. A few candidates unsure what should happen in tubes B and C recorded hybrid results, “yellow with some black” was common.

Teaching tip

Exercises to create tables requiring multiple data e.g. time, volume, colour change, concentrations etc. should provide useful practice in table design and organising headings. If helpful for clarity, the inclusion of keys could be suggested. Candidates should be encouraged to always include test-tube contents in their tables.

Q.1(a) Most candidates understood that the extract had been filtered to remove starch grains so a test with iodine was to make sure no starch was present. Very few realised that this procedure could also show the expected result at time zero for the tubes.

Q.1(b) Despite being given a cold extract to work with, most candidates answered in terms of inactivating enzymes or slowing down the reaction. At this point they had not added the solutions required to start the reaction so this could not have been the reason for keeping the extract in an ice-cold water-bath.

Q.1(c) This question was a good discriminator of the candidate's ability to describe their observations accurately and use information provided to explain their results. Candidates scored well on observation points and the determination of whether starch was present. Fewer successfully used the information in the stem to explain their observations. Candidates who did well used the information provided about reversible reactions to describe the equilibrium in the three tubes. Others applied their AS knowledge of enzyme specificity, active sites and enzyme-substrate complexes to gain marks. Candidates who described the hydrolysis or “breaking down” of glucose-1-phosphate to form starch lost a mark. Examiners commented that some Candidates were distracted by expectations of starch being formed in B. “Blacky yellow” was a description used in Q.1(c) although results tables recorded no change or yellow seen.

Q.1(d) Candidates understood that starch forms glucose-1-phosphate but generally did not gain any further marks for commenting on the equilibrium. Some Candidates concentrated on the fact that the iodine remains yellow and gave lengthy descriptions of the mechanism of the iodine test which were not credited.

Q.1(e) Success in this question hinged on realising that a quantitative result required the calculation of the concentration of starch in the test tubes. Higher scoring candidates described the use of a colorimeter to do this. The majority of candidates who realised numerical data was required thought this should be obtained by recording the time at which iodine changed colour or allocating a number to the depth of colour shown. As candidates were expecting this section to contain a question on improvement of procedures descriptions of using accurate stopwatches or measuring equipment were common and candidates lost marks.

Q1 (f) Most candidates gained three marks for describing how the procedure could be repeated using no enzyme or extract, and no change would be expected. Methods involving denaturing the enzyme by high temperature or pH changes were also described. Few candidates thought about expecting a $Q_{10} = 2$ if a range of temperatures were used or described the use of an inhibitor.

Q.1 (g) This question was very well done. Candidates are now used to the idea that they will need to criticise experiments or provide suggestions to increase reliability. Most candidates successfully described two methods of improvement or gave relevant criticisms.

Q.2 (a)(i) Virtually all candidates were able to identify and label the pollen sac as the site of meiosis in a *Lilium* anther.

Q.2 (a)(ii) This was a straightforward task to draw one cell in metaphase of meiosis and Candidates gained full marks for drawings and labels. Only a few candidates drew a cell showing anaphase. A large number of candidates included a labelled cell wall drawing a clear set of double lines to represent the wall. However, the quality of drawings was let down by blunt pencils, imprecise lines and inappropriate shading. Although for this exercise shading of chromosomes was acceptable a number of candidates produced stippling in the cytoplasm. Structures not visible such as centrioles were commonly drawn. Many drawings recorded not what candidates had seen, but a text book diagram version. A mark was lost if chromosomes were drawn as single lines.

Teaching tip

Present candidates with a range of slides, such as of cell development, where the subject and details are difficult to differentiate or discern. This should promote candidate's confidence in drawing the outlines of amorphous masses as correct observations.

Q.2(b) Good recall of synoptic knowledge was shown here and most candidates described the cells produced as haploid and showing genetic variation.

Q.2(c)(i) The majority of candidates recognised prophase and a good number realised this must be meiosis one.

Q.2(c)(ii) As an observation exercise candidates were not penalised for a wrong identification of the stage and marks could be gained for a description of the photomicrograph. Points such as chromosomes visible, not at equator and nuclear envelope present all gained credit.

Q.2(c)(iii) A clear differentiation was shown between candidates who understood the process of meiosis and gained full marks and those who were unclear. A number of candidates who were imprecise about what occurs during crossing over, breaking and exchange of chromosomes and genes was common.

PLAN – Very few Candidates gained less than half marks and more gained full marks than in previous sessions. Examiners noted that for this Plan, ideas were more clearly expressed and that the Plans were of a more reasonable length than in previous sessions. Spelling and grammar showed a great improvement and the QWC for spelling, punctuation and grammar (P) was rarely deducted. However, it was appreciated when Candidates word-process their Plans. A number of handwritten Plans proved very difficult to decipher.

Teaching tip

Candidates who know their handwriting can be difficult to read could be encouraged to print at least key or technical terms and sentences when submitting class work.

Candidates also need to be careful not to repeat information under several categories. For example, the same list of steps for a procedure could appear four times. One in an introduction, again in a pilot and repeated for each condition set up in the method. Problems arose due to the use of the term amount. It was unclear whether concentration, mass or volume was meant.

Teaching tip

An enzyme experiment could be used to highlight the need to distinguish between volume and concentration when writing up procedures. This could also focus on use of correct units as well as discouraging use of vague terms like amount and quantity.

Nearly all candidates planned a suitable procedure involving two environmental conditions and recorded the population growth of the two beetle species together (A). This mark was lost by candidates who described investigations using only one sex of beetle or only one species. A small number of candidates weighed beetles instead of counting them erroneously believing this to be equivalent to population growth. Others did not take into account the uneven distribution of beetles in the substrate and took samples of flour multiplying up to obtain an estimate of the colony. Predictions (B) were often vague. They did not include a statement about the effect of the condition on numbers of both species or only gave a prediction for one condition.

Teaching tip

In practical work, encourage candidates to make a prediction even if they are unsure of outcomes. Rather than giving no information if they believe a condition will have no effect they should state this.

A number of candidates picked type of food or food value of flour as a condition, but failed to use a balance to weigh the flour. Measuring cylinders were a common piece of equipment (C) used instead. There was evidence of candidate sensitivity to the use of live animals. Few subjected beetles to extreme or lethal conditions (G) and discussions of immobilising for counting showed concern that no harm should be done. Centres had prepared candidates well for the application of scientific procedures. Candidates identified two key variables to control, took at least five measurements within a reasonable range and suggested using at least three cultures per set of conditions. Hence they easily gained E, F, G and H. Good application was made of AS and A level knowledge of interspecific competition and population growth gaining I and D. Most candidates included details of the competitive exclusion principle and described how beetles may be competing for the same niche (gaining Q). Very few candidates used preliminary work in developing a Plan (J). Some misunderstood the concept and thought that quoting other people's work obtained from secondary sources was their preliminary work and that this constituted a pilot. Although Centres may not have wished to purchase beetles or given time to investigations

involving lengthy life cycles a reduced form of preliminary work could have been done. Candidates were credited for simple ideas such as working out the volume of containers to use and filling them with flour to obtain a suitable range of mass. This session, candidates showed a better understanding of the need to state a hazard and appropriate precaution (K) so candidates picked up this point usually for mentioning the risk of allergies and use of masks or gloves. Most candidates considered ways of obtaining precise results (M). Those who had worked with live beetles realised that it is difficult to distinguish between the species and gained T and M for use of a microscope or hand lens. N was awarded less frequently in this session as many candidates failed to acknowledge their sources. Examiners commented that a number of candidates inserted numbers that were inconspicuous, faint or in a tiny type face. Sources should be clearly or boldly referenced in the Plan's text.

Teaching tip

Candidates should be coached in the use and referencing of secondary material. They should be encouraged to consider the relevance of Internet text and not simply import it into their Plans. Sources should be numbered in the text with a bibliography or footnotes used.

Tables were well drawn and included correct units in relevant headings (O) however, many candidates lost the mark for the graph (R) as time was used on one axis. An increasing number of candidates are selecting a suitable statistical test, here Chi-square or t-test. Candidates who commented on validity and considered the effect of intraspecific competition produced some excellent sections. Some candidates described setting up single species cultures to identify and further investigate the effect of intraspecific competition gaining U.

Grade Thresholds

Advanced GCE Biology 3881 7881
January 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
2801	Raw	60	42	37	32	27	23	0
	UMS	90	72	63	54	45	36	0
2802	Raw	60	45	41	37	33	30	0
	UMS	90	72	63	54	45	36	0
2803A	Raw	120	95	85	75	65	55	0
	UMS	120	96	84	72	60	48	0
2803B	Raw	120	95	85	75	65	55	0
	UMS	120	96	84	72	60	48	0
2803C	Raw	120	84	76	68	60	52	0
	UMS	120	96	84	72	60	48	0
2804	Raw	90	63	56	49	43	37	0
	UMS	90	72	63	54	45	36	0
2805 A	Raw	90	60	54	49	44	39	0
	UMS	90	72	63	54	45	36	0
2805 B	Raw	90	59	53	47	41	35	0
	UMS	90	72	63	54	45	36	0
2805 C	Raw	90	60	54	48	43	38	0
	UMS	90	72	63	54	45	36	0
2805 D	Raw	90	66	59	52	45	39	0
	UMS	90	72	63	54	45	36	0
2805 E	Raw	90	65	58	51	44	38	0
	UMS	90	72	63	54	45	36	0
2806 A	Raw	120	91	82	73	64	56	0
	UMS	120	96	84	72	60	48	0
2806 B	Raw	120	91	82	73	64	56	0
	UMS	120	96	84	72	60	48	0
2806 C	Raw	120	87	79	71	63	55	0
	UMS	120	96	84	72	60	48	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3881	300	240	210	180	150	120	0
7881	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
3881	9.6	29.2	55.4	80.5	96.6	0	1462
7881	11.4	37.9	66.9	87.1	98.7	0	418

1880 candidates aggregated this series

For a description of how UMS marks are calculated see:

http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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