OCR
RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **A2 7881**

Advanced Subsidiary GCE **AS 3881**

Report on the Units

January 2008

3881/7881/MS/R/08J

Oxford Cambridge and RSA Examinations

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

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

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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Advanced Subsidiary GCE Biology (3881)

REPORT ON THE UNITS

Chief Examiner's Report

In general, the examiners felt that there was a good range of responses, with some excellent biology being displayed on occasions. There was little evidence that candidates were unduly pressed for time, though some undoubtedly did not have much to spare for checking answers. It is possible that a few candidates did not spot the final question in the Microbiology option (2805/04) despite the instruction to 'turn over' to the back page. Candidates must learn to check they have not missed such questions.

It was encouraging to note that centres seem to have taken on board much of the advice in previous reports and have incorporated it into their teaching strategies. This is not to say that all common failings have been eradicated from candidates' responses!

A recurring theme is the response to synoptic questions which is generally below that of the other parts of the paper. This seems to be a particular problem in the option papers and has been commented on in past reports. Centres should look through the option papers and use those parts of questions which have a synoptic element as teaching aids to demonstrate to candidates the way to structure responses in this area. It is also worth pointing out that the specification for the option modules indicates the need to have studied Central Concepts (2804/01) as synoptic material could come from anywhere within that unit.

Over the lifetime of this specification, examiners have expressed concerns about the mathematical skills of the candidates. We have seen a gradual improvement here and it was good to note that at A2 calculations involving percentage change had improved in the Central Concepts paper (2804/01). This was not as evident in the Growth, Development and Reproduction unit (2805/01) or within the AS units. A concern raised by several examiners this series was that candidates seem to have had undue difficulty in calculating magnifications or actual sizes, particularly if it involved the use of a provided scale bar.

There is no doubt that centres and candidates appreciate having the reports and mark schemes for each series. The problem that this can cause is that candidates seem to learn such mark schemes and then apply them to a different question. Several examiners commented on this both at AS and A2. One example was in Biology Foundation (2801) Q.4, where a question specifically on water as a transport medium was asked; this elicited many responses on all the features of water as a biological molecule – a question that has been set in the past.

Although legibility is generally acceptable, several examiners commented on the difficulty of reading excessively small handwriting. If centres are aware of such candidates, they should try to encourage a larger and thus more legible style.

The specification contains a useful list of the command words that will appear in questions with an explanation of the type of response that is expected. Candidates should be made aware of this as, for example, questions asking the candidate to 'explain' are sometimes answered as a pure description with the inevitable loss of marks. This occurred at both AS and A2. The assessment objectives at AO2 include the requirement to test the candidates' ability to 'assess the validity of biological information, experiments, inferences and statements'. Q.6 in unit 2802 was designed to test this skill. Candidates seemed to find the skill difficult and centres should practice this area.

GCE should be seen as a development of the skills and knowledge acquired at GCSE and there should also be a progression from AS to A2. Whilst many candidates showed that they have mastered this academic development, it is of concern to examiners that some candidates have not reached the required level in various ways. These include:

- Correct use of biological terms. An example from the AS practical exam was describing the starch grains in bananas as 'starch cells' in a significant number of cases.
- Using the term 'Fair Test' unqualified. This should be avoided. When citing the use of a control it should be qualified to explain its use.
- The use of 'it' and 'they' in questions. This can lead to confusion as to what they refer to. Candidates should be more precise in their descriptions.
- The handling of unfamiliar material. Candidates must expect to have to handle such material at all levels and particularly in the Unifying Concepts paper (2806/01). Centres would be well advised to give candidates practice in applying biological principles to a variety of novel material.
- Expressing ideas in a logical sequence. Extended writing requires the candidate to follow ideas through in a logical way. In shorter paragraphs, answers worth 3, 4 or 5 marks, the same logical approach is looked for and candidates should use the mark allocation as a guide to the depth to which their answer should go.

2801 Biology Foundation

General Comments

Some very good scripts were seen, with many candidates indicating a comprehensive understanding of the subject material and expressing their knowledge and ideas clearly and concisely. Significant numbers of candidates experienced difficulty in answering specific and detailed questions about certain areas of the specification. An apparent lack of care in reading the question led to misinterpretation, resulting in some candidates relating correct facts but not relevant to the question that had been asked. In certain questions, far more detail was provided than required by the command word.

Teaching Tip
Encourage candidates to go into the examination with a pencil or highlighter. It is useful to highlight a few key words in the question so that the focus of the question is indicated. It is also useful to indicate the command word in this way.

Comments on Individual Questions

Question No

1 **(a)** was intended as a reasonably straightforward introduction to the paper. Even some of the more able candidates, however, were unable to score full marks here. Care should be taken with spelling of words that could potentially be confused with other biological terms. On this occasion, the correct spelling of 'glycosidic' was required for **(iii)**. The most common error was in **(iv)**, where many answers simply stated 'gamete' rather than concentrating on the nucleus.

The definition of a habitat in **(b)** was generally well known. Many candidates could correctly define niche, but many thought that it represented a restricted area of the habitat rather than the role of an organism. Further marks were available for giving exemplification of a role and for correctly stating an example of both habitat and niche. Consequently, more able candidates could score maximum marks if they gave a more comprehensive answer than simply defining each term.

2 **(a)(i)** was generally well answered, with most candidates stating a suitable feature.
(ii) was more demanding, with candidates often failing to specify *aerobic* respiration; although further comment on ATP production would gain the mark. Some candidates, having stated 'nucleus' as their answer to **(i)**, then proceeded to state the function of the nucleus rather than the mitochondrion. Many candidates experienced difficulty with the calculation of magnification in **(iii)**. The most common error was to convert μm incorrectly, resulting in an answer that was out by a factor of 10 (in either direction) or even by 100. In this situation, those candidates who show their working can possibly gain credit for knowing what to divide and which figure to divide it by. When a scale bar is provided, candidates are expected to make use of it directly in the calculation rather than measuring an unspecified part of the micrograph, finding out how many times the scale bar fits into this distance, then multiplying up the scale bar units and then, finally, working out the magnification. Consequently, in this question, candidates were expected to divide 35mm by 25μm, having first of all obtained the measurements in common units, producing an answer of x1400. Credit is not given for simply stating a formula or drawing a triangle. Examiners are looking for evidence that candidates can apply this information to a particular situation.
In **(b)** most candidates identified telophase or cytokinesis as the stage shown in the figure.

(c) was answered well. Some candidates, in **(i)**, did not give the general term 'carcinogens' but suggested specific compounds, which was not required. **(ii)** and **(iii)** were also answered well, although some candidates did not concentrate on lung cancer as required by the question. The causes and legislation given were, therefore, inappropriate.

3 **(a)(i)** was answered well by many candidates. Some did not appreciate that they needed to visualise the two molecules when not joined by the peptide bond and so made incorrect statements about NH_2 and COOH groups. Some expressed themselves poorly, referring to sulphur ions, sulphur molecules, extra sulphur and sodium. In **(ii)**, candidates generally gave one of the three acceptable answers, although a wide variety of atom and bond combinations were enclosed in a line.

Most candidates answered **(b)** by referring to a line of amino acids. Significant numbers did not mention the idea of 'order' or 'sequence' in their answer and so failed to score. Many candidates answered **(c)(i)** correctly. The intention in **(ii)** was to provide candidates with clear instructions and a template by which they could make comparative statements. The first row, completed for the candidates, was intended to reinforce this. Despite this, however, some candidates completed the table with random (although correct) statements about haemoglobin which did not score. In the second space, candidates were required to comment on the number of *types* of polypeptide chain. Non-scoring responses included '2 polypeptide chains', '4 polypeptide chains' or 'α-glucose and β-glucose'. None of these referred to the number of *types*, with the glucose reference being clearly wrong. In the final space, candidates were expected to state a function. The idea of transport or carrying in some appropriate context was therefore expected. It was not enough to state that 'haemoglobin binds with oxygen' or 'it forms oxyhaemoglobin'.

4 Many candidates lost the focus of one or both parts of this question. It is not clear whether this was because they had not identified the key phrases in the question or whether they were intent on answering the question that they had prepared for, rather than the one that had been asked.

(a) specifically related to the role of water as a transport medium. The diagram was provided as a trigger to help the candidates think about hydrogen bonding. Some candidates answered the question clearly and to the point. Many, however, referred to hydrogen or oxygen ions or to water as a charged molecule. Many references to hydrogen bonding were seen, but often in vague or inaccurate contexts. Examiners were expecting to see a clear statement that hydrogen bonds are formed between water molecules. The presence of hydrogen bonding explains why water can move as a body or single, unbroken unit. While references to flowing were often seen, few made this connection. There were many good descriptions of water as a solvent, often with good detail of the dissolving process. Some candidates, however, did not state the nature of the solute or give an example. There was some confusion between the terms solvent and solute. The importance of water as a liquid was usually noted, but often qualified as being at 'room' or 'body' temperature. This was inadequate, as its liquid nature over a wide range of temperatures should have been appreciated. The idea that water can transport solid objects would have gained credit. A significant number of candidates referred to cohesion, adhesion and surface tension and made no reference at all to transport. Others simply gave details of the general properties of water.
Once again, some candidates failed to see the significance of 'roles of the different components' stated in **(b)**. Consequently, the answers supplied by these candidates ranged from descriptions of the structure of the cell surface membrane (with no stated functions), to the functions of membranes (both inside and at the surface of the cell) and to a description of the contents of a eukaryotic cell. Better responses clearly linked the roles to the correct component, although many spent much time and effort on a detailed

description of each component, which was not required, with little reference to the role. There was a great deal of inaccuracy and imprecise expression. Cholesterol, for example, was thought to regulate the fluidity of the cell, rather than of the cell membrane. It was disappointing that this fluid nature was not associated with the ability of the membrane to carry out the various forms of bulk flow, even though many references to exocytosis etc. were seen. Surface proteins were stated to be responsible for attachment of cells, hormones and neurotransmitters rather than glycoproteins and glycolipids. Hormone recognition was stated rather than hormone attachment. Many scientific terms relating to function were incorporated into responses, but as they were required to be in the correct context the QWC mark was rarely awarded.

5 Many candidates answered **(a)** well but a wide variety of combinations of answers was seen. Even weak candidates managed to score at least one mark. Although mRNA had been written in bold in the question, this and the other information given had obviously escaped some candidates. The importance of reading the information supplied very carefully cannot be over-emphasised. It can often allow a candidate to spot the clues provided and to ensure that they do not simply latch onto the first idea that they have, which may not be relevant in the context of the question. Some inventive calculations were seen and the most common error was to give 78% and 72% instead of 22% and 28%.

Performance on **(b)** varied considerably. **(i)** was answered correctly by many candidates but a significant number incorrectly gave 'codon' or even 'mRNA' as the answer. The command word for **(ii)** was clearly stated as 'outline'. A detailed account of protein synthesis was not required, but this was provided by many candidates who did not manage to make the salient points. The question was intended to explore the relationship between the DNA nucleotide sequence and the production of a protein such as pectinase. One mark was available for simply stating that pectinase, or an enzyme, was a protein. The level of detail required in such an answer would typically be: 'DNA codes for protein and pectinase is a protein. Three nucleotides code for an amino acid. The nucleotide sequence is transcribed onto mRNA and then translated at the ribosome to form the protein. The nucleotide sequence determines the order of the amino acids in the protein.' It is clear that many candidates have no more than a tentative grasp on this knowledge. They are confused between the types of RNA, the terms codon and anticodon and seem to think that the process actually makes amino acids rather than arranging them in the correct order for formation of a particular protein.
In **(c)(i)**, many candidates successfully described the unchanging transmission in tube 4 in terms of the boiling and denaturation of the enzyme. Commenting on tube 1 proved to be more of a challenge as incomplete descriptions were often given. Candidates were expected to note the increase in transmission up to 70% or 50 minutes and then to state that, after that point, the transmission levelled off or showed no change. Explanations were often muddles, with weaker responses answering in terms of the effects of increasing temperature and referring to V_{max}. In **(ii)** many candidates correctly referred to tube 2 as the control. Explanations, however, were not clearly expressed. Candidates should be aware of the difference between a control, as a standard to measure the observed changes against, and the idea of a fair test, which is concerned with the control of variables. References to fair test were not relevant and not credited. A variety of lines were seen on the graph in **(iii)** and about half of the candidates did not answer on the graph on page 14 but drew their own in the space at the bottom of page 15. These graphs were marked but many of them, although showing a horizontal line, could not gain credit because they did not provide a scale on the vertical axis and so it was not possible to know whether the line was in the required range of 70% - 100% transmission.

6 Many candidates find the concept of the nitrogen cycle difficult and specific questions asked about it are a seen as a challenge. This was demonstrated once again in this question. Candidates should be aware that the nitrogen cycle relates to the conversion of nitrogenous compounds as well as referring to atmospheric or gaseous nitrogen. As such, they should be discouraged from referring to 'nitrogen' unless they actually mean N_2, and should be familiar with and use the correct nitrogenous compounds in the appropriate places in the cycle. It is all too easy to refer to 'nitrogen' in passing as a generic term, but it obviously leads to its misuse by candidates under examination conditions.

Consequently, only those candidates with a thorough understanding of the topic were able to score well in (a). Weaker or less confident candidates were unable to apply their knowledge of the nitrogen cycle to a layout that they had not seen before. Many responses seemed to be a random selection of terms that have been used in association with this topic. Few candidates answered both K and L correctly in (i). L was frequently given as ammonia, but examiners were accepting ammonium as a possible response. Many candidates gave excretion for both M and N in (ii), presumably on the basis that at least one of them would be correct. Urination was also frequently seen for M, in which case N was then given as excretion, therefore not gaining any marks. The misconception that egestion is excretion was also carried on into (b)(i). There was some confusion between nitrification and denitrification in (iii) and some candidates confused the process with the organisms that carry out the process. If in doubt, candidates suggested nitrogen fixation, the Haber process or lightning.

2802 Human Health and Disease

General Comments

We were pleased with the performance of this examination. It allowed all candidates to show off their level of knowledge and some candidates were able to score very high mark totals. A number of questions demonstrated that responses are often centre-dependent and the quality of teaching is obviously not consistent across all centres.

Questions such as question 1 (b) where candidates had to apply their knowledge in a new way show that many candidates still struggle with assessment objective 2. There are always questions of this type and candidates need to be trained to use their knowledge in novel contexts. Plenty of practice with past examination papers can help to generate the thought processes that enable candidates to answer questions that test assessment objective 2. However, as ever, the use of past examination papers and mark schemes must come with a health warning. The tendency to learn a past mark scheme and apply it to a new question was also apparent in responses to questions 4 and 5. Questions are rarely, if ever, repeated in their exact form, therefore past mark schemes never fit exactly.

Comments on Individual Questions

Question No

1 **(a)** We have mentioned in recent years the need to write out the full generic name of pathogenic species. Again, this year, a large minority of candidates failed to use the full generic name of the cholera pathogen (*Vibrio*) or the tuberculosis pathogen (*Mycobacterium*). The use of the abbreviation (*V*. for *Vibrio* or *M*. for *Mycobacterium*) should be reserved for longer pieces of text when the name is being repeated. There were also the usual variants in the spelling of these names. Candidates should understand the need to be accurate with the use and spelling of latin names. Candidates knew the means of transmission of both malaria and tuberculosis even though some were unable to express themselves clearly. The response 'air droplets' was seen on occasion as a means of transmission for tuberculosis. Presumably the candidates concerned could not make up their minds between 'airborne' and 'water droplets'. However, 'air droplets' could not be given credit. Similarly the candidate who thought that HIV stands for Human Inefficiency Virus may be accurate in some respects but, unfortunately, could not be given credit.

(b) The examiners were disappointed that very few candidates could achieve full marks.

2 This question used some data from an exercise stress test. In general this question was well answered.

In part (a), all candidates told us that as the boy started to exercise his heart rate went up. Many candidates backed up this statement by quoting some figures from the table. Candidates were asked to describe and explain. It was apparent that many candidates need to be taught the meaning of these command words. Most candidates described, but not all attempted to explain.

Those that did attempt to explain the rise in heart rate often did so in insufficient detail. The need for **more** oxygen to supply active muscles that are respiring at a **faster rate** was not made clear.

(b) This question revealed that too many candidates either did not read the question or did not understand what is meant by the cardiovascular system. Far too many candidates

responded by giving changes to the breathing or respiratory system. Better candidates responded with correct answers such as higher stroke volume or referred to vasodilation or vasoconstriction. However, some failed to state where these processes occurred.

(c) This question was answered correctly by most candidates who realised that they needed to calculate the maximum safe heart rate at 207 beats per minute. There was some confusion between maximum safe heart rate and maximum heart rate.

(d) There were many disappointing responses to part (d). The question asked how the boy could improve his physical fitness. Many candidates gave a response that was more appropriate to part (e) rather than stating that he needs to carry out aerobic exercise for 20 minutes three times a week.

(e) Even more disappointing was that these same candidates repeated their answer in part (e). Candidates should realise that we are unlikely to set the same question twice. Therefore, if they are giving the same answer, one of them must be incorrect.

Teaching tip
Play word chase games (or a simplified version of consequences) using cards to match a sequence of events such as the changes in the circulatory system during exercise. Provide students with crosswords using the definitions of terms as the clues. (The 'hot potatoes' website is a useful aid.)

3 This question tested a learning outcome from the specification that is not tested frequently. It supplied some information about the lifestyle of two women and invited candidates to assess their level of health.

(a) This question was generally answered very well although candidates did not always make clear comparisons. Many candidates answered by describing aspects of one of the women rather than making comparative statements. It may help candidates to think of answering such questions in the form of a table. This would ensure that full comparisons were made.

(b) In part (b) many candidates started by writing out the World Health Organisation definition of health. This did not gain credit as candidates were expected to apply this definition to the lifestyle adopted by the two women. Despite this, most candidates achieved two or three marks here. We were pleased to see that many candidates were able to understand that woman B was likely to be suffering from stress and depression. That is not to say that this is the normal situation for women who have three young children.

(c) This part was less well answered and candidates need to consider their answers more carefully. Many candidates made sweeping statements that actually have little meaning – such as 'to study patterns of disease'. We were looking for a more detailed response suggesting, perhaps, that candidates understood that such studies allowed links to be made between lifestyle and the risk of developing certain diseases.

Teaching Tip:
Encourage students to use tables for making comparisons. Each row of the table should contain matching statements.

4 We have received a large number of insert pictures returned with scripts. It has been suggested in the past that centres may like to keep such inserts to use as teaching aids. The insert showed photomicrographs of healthy lung tissue and tissue from the lung of a person with emphysema.

(a) Within this part, most candidates gained credit for describing how the tissue in each photomicrograph was different. However, some candidates were too vague with responses such as 'the tissue is all broken up'. We were looking for accurate statements that reflected some knowledge of lung structure – 'the alveoli have been damaged' was a typical acceptable response.

(b) Candidates knew how emphysema affects the person with the disease and most candidates achieved full marks in part (b).

(c) This part proved to be the most discriminating part of this question. Good candidates were able to describe a clear sequence of events leading to the bursting of the alveoli. Weaker candidates made a range of errors which included suggestions such as: 'alveoli contract', 'cilia are killed' and 'tar contains the enzyme elastase'. These are common errors that we have commented on in previous years. Alveoli can recoil rather than contract, the cilia are damaged or paralysed rather than being killed and the elastase must come from phagocytic cells not the tar.

(d) Within this question, many candidates gained credit for one piece of epidemiological evidence linking smoking to lung cancer and for some experimental evidence. A lot of candidates, however, simply rephrased the same point as a second piece of epidemiological evidence. Also, a surprising number of candidates gave responses that confused the experimental evidence with the epidemiological evidence. A good proportion of candidates believed that '80% of smokers get lung cancer'. What they meant to say was that 80% of people with lung cancer are smokers.

Candidates must be encouraged to reread their answers to check that they have written something sensible.

Teaching tip:
Use card sort games to help students learn the sequence of events in a process such as the damage caused by smoking.

5 **(a)** Most candidates realised that being given passive immunity meant being given antibodies. However, some candidates then went on to describe how the immune system is activated by this injection of antibodies rather than suggesting that this gave immediate immunity.

(b) In this part, the majority of candidates set out their responses well by first describing how a vaccination can provide immunity and then explaining why not all vaccinations work effectively. Good candidates were able to provide a well written and organised account of how the immune system is activated by antigens from a pathogenic organism and followed this with sound reasons why the process did not always work. These candidates almost always also achieved their mark for quality of communication. However, there was one area of confusion that was seen frequently even in the better candidates. Many candidates confuse the terms 'pathogen' and 'disease'. It is the pathogen that has antigens on its surface and it is the pathogen that shows variation or undergoes antigenic shift, it is also a weakened form of the pathogen that is injected during vaccination. A disease does none of these things. Weaker candidates gave brief accounts that mentioned B lymphocytes, T killer cells and a variety of other components of the immune system. These accounts were often very confused and lacked any clear sequential arrangement.

Candidates should be encouraged to think of this topic as a flow diagram – where one action instigates another. The key point that immunity is achieved by memory cells in the blood was missed by many.

Teaching tip
Devise a board game in which students move around the board and collect cards describing one step in the immune response. The aim is to collect a full set of cards describing the immune response. This can be made more complex using 'go back to start due to antigenic shift' type cards.

6 Many candidates did not seem prepared for a question that asked them to 'comment on the significance'. A good proportion seemed to think this was a 'is this correct or not?' question.

Responses often started with 'this is significant' or 'this is not significant because...'. This was particularly surprising when applied to the fatty acid section. Having been told that vegans have a lot of essential fatty acids in their diet, alot of candidates went on to argue that vegans do not have many essential fatty acids in their diet.

The quality of the responses given in this question did not always match up with the overall ability of the candidate. Many candidates missed the significance of these dietary factors to the health of the vegan but others gained marks simply by writing down what they knew about each dietary factor.

2803/01 Transport - Written Paper

General Comments

There was a good range of marks. Candidates found some of the questions pleasantly accessible and thus there were fewer really low scores noted. Candidates were generally well prepared, displayed good subject knowledge in most areas and answered the questions thoroughly. Most candidates scored at least some marks on each question. Weaker responses seemed to be partially due to some lack of preparation. It was good to note that many responses indicated that centres have taken on board comments from previous reports. Dissociation curves and percentage changes remain areas of difficulty. There was no evidence that candidates experienced problems in completing the paper in the time specified.

Comments on Individual Questions

Question number

Q1 This was designed as a fairly gentle opening question and it proved such with many good marks.

(a) It was not uncommon to see full marks here. The commonest errors were to confuse the bicuspid and tricuspid valves. A few candidates transposed atria and ventricles – identifying **P** as the left ventricle. **T** or **U** occasionally became the coronary arteries.

Q2 It was encouraging to see that the plant orientated question did not pose so much of a concern as it often has in the past. Centres are to be congratulated on tackling these areas successfully

(a) The last time the identification of a plant organ was set, a very significant number of candidates misidentified it – even to the extent of suggesting and animal structure. This time very many correctly identified the stem. There were a few roots and vascular bundles. Although a majority correctly identified the phloem as tissue **E**, there were a significant number who chose **A** or **B**. Sucrose was usually stated as the assimilate transported. Weaker responses were sugar or glucose.

(b) The idea of source and sink seems now to be well understood. The weaker responses just repeated the stem of the question by making comments about where the assimilate came from or went to.

(c) It was good to see that many centres seem to have got to grips with this topic. There were many excellent, concise answers explaining exactly how the assimilate gets from source to sink via a pressure driven mass flow process down the length of the phloem. The vast majority described the hydrogen pump mechanism for the loading part of the process rather than that involving conversion to rafinose. Candidates who tried to mention both mechanisms often muddled them and lost marks. Weaker answers made general references to pumping protons without indicating where they were pumped from or to. Good answers needed to indicate clearly the role of the companion cell and sieve tube not just general references to 'phloem'. Some candidates concentrated solely on the loading with little or no mention of the movement down the length of the sieve tubes or of unloading. Full marks were not possible if loading alone was discussed.
Some candidates still confused xylem and phloem mechanisms and talked about cohesion tension theories and uptake of assimilates from the soil.

Teaching tip
As the specification only requires one possible mechanism to be discussed, perhaps it would be wise for centres to the teaching of one theory to avoid confusion.

Q3 Dissociation curves once again proved a difficult area.

(a) Although the majority of candidates got the correct response of 4 molecules, incorrect responses ranged from 1 to several hundred. Many candidates were able to correctly explain the shaped of the curve in terms of the relative ease or difficulty with which successive oxygen molecules attach to the haemoglobin molecule and scored both marks. Weaker responses just talked about changes in partial pressure thus failing to grasp the key idea and so scored zero.

(b) This question was very badly attempted. The idea of part (b)(ii) was to ease the candidates into this section. Unfortunately it did not seem to. The vast majority talked about association. There is a good reason for it being called a **dissociation** curve. Candidates should be taught to think in terms of the bodies needs for oxygen and to read the curve from right to left. Very many candidates seemed to think that a partial pressure of 4 kPa represented the lungs band thus region **X** was where effective loading occurred. There were some logical answers which started by recognising that the region x corresponds to the range of partial pressures found in most of the actively respiring tissues of the body. These tissues have a high oxygen requirement. Thus as blood passes through such areas a small **drop** in their partial pressure will result in considerable unloading of oxygen as seen by the decrease in saturation. There was credit for a suitable figures quote to support this.

(c) (i) Although a majority of candidates drew the curve to the right, perhaps 15% had it on the wrong side. Examiners were reasonably tolerant as to where the curve hit the vertical axis at a partial pressure of 12 kPa.
(ii) The side that the candidates had drawn their curve in (i) did not seem to affect their answers to this part. This again suggests that they do not fully appreciate what a dissociation curve shows. Many were able to explain that it would mean that more oxygen would be released for a given partial pressure of oxygen and link this to the higher level of carbon dioxide in tissues like respiring muscle which need the release of more oxygen.

Teaching tip
Continue to stress that the curves are dissociation curves. Get candidates to mark the sorts of parts of the body to which various areas correspond and to calculated % release of oxygen over given ranges.

Q4 This was a high scoring question. Candidates seem to have grasped the basic ideas here thoroughly. Many scored full marks. The commonest errors were to consider the desert habitats as hot or harsh rather than dry in this context, to state that xerophytic leaves stop all transpiration or that hairs trap water droplets rather than vapour.

Q5 This seemed an approachable question to many candidates. It required some detail and logical thought. Weaker responses lost their marks by being too general in their responses.

(a) **(i)** Percentage changes have often caused some difficulty and this was no exception. The question asked for the percentage by which the number of red cells in the man was greater than that in the woman. Many reversed the idea.
(ii) Good answers followed the ideas through from the lack of oxygen at altitude so the haemoglobin won't be fully saturated, to the extra haemoglobin which more red blood cells would provide meaning that extra oxygen could be carried to cells needing it. Weaker responses just had more red blood cells carrying more oxygen without reference to haemoglobin or to where the oxygen was going. some even thought that by having more haemoglobin the affinity for oxygen was increased. surprisingly few candidates mentioned reducing the risk or effects of altitude sickness.
(iii) Most got at least two marks here, usually by suggesting standardised ages or genders or by increasing the number of subjects at the different altitudes. A number of other good points were made.

(b) **(i)** Again there were many good answers in terms of the formation of carbonic acid, its dissociation and the role of the H ions in oxygen release. A significant number of candidates wrote about the formation of carboxyhaemoglobin or carbaminohaemoglobin for which there was no credit.
(ii) The information at the start of part (b) was intended to allow the candidates to link taking acetazolamide to increased breathing rate or depth thus taking in more oxygen. As it was a 'suggest' question, credit was also given for the idea that it might work by reducing haemoglobinic acid and thus more oxyhaemoglobin would carried round the body to where it was needed.

2803/02 and 2806/02 Transport/ Uni-Concepts/Skills – Coursework 1 & 2

1. General Comments:

As with previous January entries the work presented for moderation fell into two categories, resubmission of small numbers of candidates over a comparatively large number of centres and secondly a few centres entering complete cohorts for first assessment. The latter was generally of good quality and compared favourably with previous sessions, being well marked and annotated. The work offered for a second time seemed to have changed very little and scored much the same. It is accepted the entering a single candidate, may pay dividends when a centre has had the scores adjusted at the last session. However, it seemed that the reasons for adjustment had often not been addressed and the single candidate suffered the same adjustment. Resubmitted material must have been reworked, preferably by the candidate producing new results, and then be marked again, taking into account the comments on the moderator's report to the centre, if it is to show an improved score.

In some centres where the staff are newly qualified or inexperienced in coursework teaching, the marking has lacked consistency and accuracy. It is strongly recommended that such centres attend INSET provided by the Board and/or take advantage of the consultation service available to check the validity of an assessment exercise and it's 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.

2. Comments on Individual descriptors:

A cause for concern is the often poor quality of scientific knowledge and understanding (SKU) used in skill A. Centres should credit A5bi when candidates have submitted material at a minimum of grade E standard (the same standard applies for P5ai). 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, at A2 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.

Statistical analysis is a useful skill and enhances work at this level, particularly at A2. Some candidates spend a good deal of time developing conclusions based on the stats. However, since A5bi and A7bi require relevant scientific knowledge and understanding, conclusions based on statistical reliability often do not match those descriptors.

For P3b the candidate decides on a suitable number and range of observations and/or measurements to be made. Repeats are needed for reliability to be assessed, so at least 3 replicates should be planned for. If this plan is to be used and the results analysed it should be noted that the calculation of a mean is less reliable with data taken from less than 3 readings; 3 readings will also aid the identification of anomalous results for use in skill E. A range of 5 in the independent variable is expected, but the exact number depends on the context of the investigation and the independent variable studied. If in doubt the centre should contact the subject officer at OCR. In the case of ecology it can be appropriate to study a range of 2 e.g. exposed and sheltered shores. However, the centre should endeavour to set a planning task

where a range of 5 is possible. A common example where confusion still exists is in a microbiology investigation of mouthwashes or anti-bacterials. Candidates often attempt to study an inappropriate range often with confusing statements about replicates and muddles over a variety of bacteria. Centres should require simplicity in planning where it would be appropriate to consider one product with five dilutions and three replicates. However to maintain the rigour of the centre's scheme of work it is acceptable to provide a work sheet for Skill I that develops the exercise into a wider range of products or organisms once the planning stage is complete.

For A3a the candidate processes and presents evidence gathered from experimental work including, where appropriate, the use of appropriate graphical and/or numerical techniques. The presentation of the processed data, e.g. %, should be in a suitable and correct graphical format that allows further data to be extracted. In some cases the presentation of the details of calculations in processing may be used to match this descriptor. At A2 details of the stages in the calculation of a chi squared test or other statistical processes might meet this descriptor. A hand drawn, appropriate, graph remains the best way to match this descriptor since ICT graphs submitted are often too small or lack grid lines, axis labels, units and so on. At no point has a 'perfect graph' been acceptable for A5a.

2803/03 Practical Examination

General Comments

This paper was set in the context of two aspects of *Human Health and Disease*, but drew on the three modules of the AS specification.

The planning exercise involved investigating the effect of temperature on the ripening of bananas. Candidates appear not to have much time to devote to preliminary practical work in the winter examination; it was clear that many would have benefited from some more time in the laboratory thinking through their strategies and trying some practical ideas over a longer time span.

As part of the planning, the candidates may have used Benedict's reagent to assess the concentration of reducing sugars and/or non-reducing sugars in bananas. In Q.1 the candidates used the potassium manganate (VII) method for producing a calibration curve to identify the glucose concentration of two solutions made up to represent 'sports/energy' drinks.

The Examiners were disappointed with the large number of poorly drawn graphs for Q.1. Tables of data revealed that almost all candidates found the correct trend in their results, but many presented graphs with the following mistakes.

- Axes drawn the wrong way around with the dependent variable (time to reach end point) on the x axis.
- No scale for concentration instead the test-tube letters (A to E) or glucose concentrations used plotted equidistant along the x or y axis.
- Choice of a scale that used half or less than half the width of the graph paper
- No line to show the relationship investigated.
- Axes starting with 20% instead of 0%.

This first arose in the examination in January 2004. Perhaps, as then, the candidates may have avoided plotting test-tube letters if the question has asked for a graph of time for decolourisation against glucose concentration.

Answers to subsequent questions were better than in many previous papers.

In Q.2, candidates were presented with a slide of aorta and asked to draw a low power plan with labels and annotations. The quality of drawing, labelling and annotation varied considerably. Annotations in particular were very poor or non-existent. Most candidates knew the names of the layers of the wall.

Comments on Individual Questions

The Planning Exercise

The examiners were pleased to find that most of the plans were written in a concise fashion. The vast majority were word processed. Candidates tended to avoid lengthy accounts of the relevant, or irrelevant, theory involved in the exercise. Unfortunately, many candidates thought that this was simply an investigation of the effect of temperature on the rate of an enzyme-catalysed reaction. They missed the key word 'ripening' in the task. As a result they planned to put pieces of banana into test-tubes, leave them for a few minutes and then test for starch or reducing sugar. Better plans involved taking bananas of the same degree of ripeness and keeping them at a range of temperatures for several days before testing them for the presence of starch and/or reducing sugars.

Preliminary work seemed to be the key here. Some candidates put bananas into ovens or incubators for anything up to a week and tested them at intervals to find the best time span to use. Others planned to test the bananas every day and therefore suggested putting up to seven or eight bananas into each temperature. The examiners considered 24 hours to be the minimum time for this treatment and did not award checking point **A** (for a suitable procedure) unless this was done. Many candidates did not score **A**.

The choice of strategy obviously had consequences for other checking points. The candidates were expected to choose somewhere to put their bananas and also choose a reagent (iodine solution or Benedict's solution). At least one candidate used potassium manganate (VII)! Candidates who saw this investigation simply as an enzyme experiment gained the checking point for choice of apparatus (**C**) if they chose to use a water bath for testing the effect of temperature on the banana tissue. This was given following the 'error carried forward' rule.

Almost all candidates gave a suitable prediction (**B**) although some just referred to the effect of temperature on ripening without being more specific. Predictions were supported by appropriate theory. The examiners expected candidates to refer to the hydrolysis of starch to glucose or maltose (**D**) and they often found supporting material from the sections on biological molecules and enzymes in *Biology Foundation*.

The identification of variables (**E**) was not as good as in previous plans. Fewer candidates than usual seemed able to identify these, although their methods often revealed that they had considered them.

Virtually all candidates correctly used a minimum of 5 different temperatures (**F**) of appropriate range (**G**), the examiners expecting a minimum range of 20 ^{o}C.

The quality of the preliminary practical work varied considerably. This is only to be expected at this time of year with most, if not all, candidates retaking this examination and perhaps not being given much laboratory time and perhaps doing the exercise on their own rather than as part of a class. However, some candidates lost this mark (**J**) for using preliminary work because they did not explain how their results influenced their planning. It should be pointed out that candidates do not have to carry out extensive trialling generating a large number of results. But they should record what they find – even if the results are qualitative – and then state how this information influenced their decision making.

Some candidates found the SAPS procedure for isolating starch grains. This gives a good way of estimating the starch content and is worth incorporating into routine practical work for those centres with centrifuges. The materials required for this were included in the Instructions, although the context was not! The procedure is at:

http://www-saps.plantsci.cam.ac.uk/osmoweb/starch.htm

Many candidates suggested using the colorimeter to determine the starch or reducing sugar content of bananas. Many of the descriptions were far from convincing, but some candidates trialled this and found that the material they poured into cuvettes or put into test-tubes was just too thick and opaque. They therefore decided to homogenise the banana tissue, filter and often dilute to give something that gave a suitable range of results in the colorimeter. The use of the colorimeter with the Benedict's test is problematic. Candidates did not often explain that they should filter the contents of the test-tubes after carrying out the Benedict's test and then use the filtrate. Only a few candidates explained that a solution that remained blue would indicate a zero concentration of reducing sugar, but that this would give a high reading for absorbance.

Many candidates found web sites that described the ripening process of bananas. They also discovered that sucrose is produced during the ripening process. Some stated that this would not influence their plans because there is still an increase in reducing sugar *as well as* in non-

reducing sugar so that there was no need to measure the non-reducing sugar content as well. Others used acid hydrolysis so that the concentration of sucrose could be taken into account. Some said that this would also break down some of the starch and invalidate the results. This discussion tended to gain checking points **T** and **U**. Some named other reducing sugars and said this would invalidate their findings as they were just trying to find out how much glucose was produced.

Good candidates often referred to calibrating the colorimeter and used data from previous practical work to show how this would be done. Others described the procedure – using standard concentrations of glucose – and stated that a calibration curve would be drawn. This neatly anticipated the procedure involved in Q.1 of the Practical Test.

Many candidates, again this time, correctly identified potential hazards but fail to gain checking point (**K**) by not linking them to appropriate precautions. Many gave general laboratory precautions such as 'tying hair back' and 'tucking stools under the desk'. Many also gave information about what to do in case of emergencies. This is not credited. Candidates should state a hazard and then give an appropriate precaution that should be taken to avoid emergencies. Many candidates stated that hot water would be needed for the Benedict's test and stated that test-tube holders or 'tongs' should be used. These statements gained the mark for the safety comment.

The most disappointing aspect of the plans, yet again, was the omission of citations in the text to the resources used (**O**). Few candidates gave lengthy lists of resources as often happens. However, many had clearly used resources, such as the SAPS web site mentioned above, but failed to indicate where they had been used in the plan.

Practical Test

Q1 The Examiners were very grateful for the sample results provided by most centres. Some centres commented that it was much colder on the day of the examination than it had been when the sample results were taken. OCR can plan for most things but not the temperature of laboratories on the day of examinations!

(a) **(i)** Most candidates stated that tube Z helped them to decide on the point when the potassium manganate (VII) solution was decolourised. Very few stated that it would also help to make sure that the same point was chosen each time. Simple references to 'controls' or 'comparisons' did not gain any credit.

(ii) Most candidates interpreted this question as something to do with kinetic energy. They thought that shaking the tube would give the reactants more energy so that the reaction would occur more quickly. In fact the reverse is true because shaking would introduce oxygen into the solutions and reverse the colour change by oxidising any manganate (II) that has formed. A very small minority understood this.

(b) The examiners were pleased with many of the tables of data. Candidates gave well formatted tables giving glucose concentration to the left of the results of the timing. 'Time' alone as a column heading was considered insufficient. Most candidates gave 'time for decolourisation of potassium manganate' or some suitable alternative. The results usually showed the correct trend although some timings were much longer than anticipated. Candidates were not penalised for this; the Examiners rewarded the correct trend with the solutions in the correct sequence.

The units used for time were often confused; a minority of candidates mixing minutes with seconds, e.g. 3.50 min - is this 3 min 50 sec or 3 min 30 sec. Candidates were expected to express their time units in seconds to be awarded the

appropriate unit mark. Expressing time in minutes and seconds led to some candidates plotting the points on the graph incorrectly, e.g. plotting 3 min and 50 sec as 3.5.

(c) As mentioned in the General Comments above, many of the points made about graphs in the report on the January 2004 paper are still just as valid. Many candidates did not present their results in the accepted form. Axes were frequently the wrong way round, poorly scaled or too short. Many had their points falling nicely on a smooth curve, but insisted on drawing a straight line through some of the points. This often meant that estimates of **F** and/or **G** were incorrect although they would have been correct if a smooth curve had been drawn. There was evidence of results being 'doctored' to fit axes on the graph, e.g. where the original figure went off the top of the scale, and also when an anomalous result had occurred.

(d) Descriptions of the graph were generally good and most candidates were awarded three out of the four marks available. The majority of candidates used figures from the graph to illustrate their descriptions. Explanations were less successful with many ignoring the instruction to explain the trend. Of those that did, most referred to glucose as a reducing sugar and explained that the decrease in time with an increase in glucose concentration was the result of more collisions. Some were misled into thinking that this was an enzyme-catalysed change and referred to enzymes and substrates here.

(e) The Examiners awarded marks for stating times for **F** and **G** and using the appropriate unit (seconds or minutes and seconds) as they had done in their table of results. The Examiners then checked that the time for **F** was greater than that for **G**. They looked for intercepts on the graph – these had to be lines drawn from the y axis to the calibration curve and then down to the x axis. Many candidates did this, although there were some that just gave a dot on the curve and that was all. Another mark was awarded for stating the concentrations that they found from using their graph and a final mark for achieving a result within the ranges **F**: 5-9% and **G**: 15-19%. For those who gave their estimates to the nearest 0.1% this range was: 5.0-9.9% and 15.0-19.9%.

(f) The Examiners applied the 'error carried forward' rule to answers to part (i) so that candidates were not disadvantaged by obtaining results different from those expected. The Examiners decided to accept 9% as a sports drink. Most candidates used some of the information from their planning exercise in answering part (ii). Most referred to fast or slow energy release and the need for starch to be digested. Few referred to glucose as a small, soluble molecule or the ease with which it is absorbed into the blood.

(g) Candidates tended to score well on this evaluation exercise. Their criticisms and improvements were usually well matched. The Examiners insisted that criticisms about the range and number of measurements were related to this specific exercise. For example, some candidates stated that there were not enough concentrations without explaining why this was a problem. Better candidates explained that it is difficult to be sure where to draw the curve if there are only five points. Some stated that it was difficult to estimate the concentration for **G** because there was little difference between the timings for 15% and 20%. Spelling errors included 'biuret' for burette which did not gain credit

General points that tend to appear each time scored marks. Candidates commented on the lack of repeat readings, fluctuating temperatures and the difficulty in determining end points. Colorimeters and thermostatically-controlled water baths were inevitably recommended as improvements to the method.

The Examiners rejected contamination as a criticism since this should not have occurred if candidates had followed the instructions in the question. Likewise they rejected comments about air bubbles in syringes.

Some candidates criticised the instructions they had been given rather than their procedure.

Q2 The slide, **K1**, was a transverse section of the aorta of a small mammal. The quality of drawings of the low power plan in (a) was quite varied as was the labelling. Only better candidates annotated their drawings appropriately. It was not necessary to describe the functions of the structures that had been labelled and it was not necessary to add the magnification of the drawing. Candidates should be advised to follow the instructions given in the examination paper. Providing extra information does not gain credit and wastes precious time.
The demands of part (b) seemed to be too great for some candidates.

(a) Drawing marks were awarded for clear, continuous lines, an oval shape for the cross section and showing two or three layers of appropriate thickness in the wall of the aorta. Some candidates shaded their drawings which lost them the first marking point. Low power plans should not include shading. However, some candidates drew small drawings to the side of their main drawing to indicate the appearance of the elastic fibres. This was fine. Some candidates could only see one layer to the wall while others saw three or more. The Examiners expected the candidates to draw two layers and label them as tunica media and tunic externa. They also expected them to label the very inner layer as the tunica intima. This was often done by a label line to the line drawn around the lumen as the intima is very thin. Often the lumen was filled with blood, but candidates thought this was another layer and it was often difficult to see how they had thought that the space around the blood was the endothelium.
Some candidates made poor use of the space provided for the drawing, producing very small drawings with labelling lines and annotations very close together.

Labelling tended to be good and many candidates identified the three regions of the wall and indicated that elastic fibres, collagen and smooth muscle are present in the wall. All three tissues appear throughout the wall so candidates gained marks wherever they showed them. A common mistake was to refer to ‘muscle’, not ‘smooth muscle’. Some candidates only labelled the outside line as the tunica externa, rather than labelling the layer. An annotation mark could not be awarded when this was done.

Annotation should have been restricted to the colour of the layers and the appearance of elastic fibres, perhaps as dark wavy lines. Many candidates offered further information about functions of the regions and tissues which was not required.

(b) In part (i), the candidates had to estimate the area of the lumen unobstructed by plaque and a blood clot. They were provided with a grid on an acetate sheet. Some candidates appeared not to have realised that the area of each small square on the acetate sheet was 4 mm^2 and did not multiply accordingly. The limits set by the Examiners were 340 to 400 mm^2. A mark was available for working where the answer fell outside this range. The ‘error carried forward’ rule applied to part (ii), so that those who missed the accepted range in (i) could gain full marks for calculating the percentage of the lumen of the artery blocked by the plaque and blood clot. The accepted answer lay between 82 and 85%.

(c) Most candidates stated that oxygen would not be supplied 'to the heart' as a result of the blockage. Many went on to say that cardiac tissue would die as a result. The Examiners expected to find the word 'muscle' used here and only awarded a mark if it was so used. Smaller numbers of candidates referred to the supply of glucose although some did explain that it would be difficult for cardiac muscle to respire aerobically. Few candidates referred to the build up of wastes, such as carbon dioxide or lactate. Some explained that there would be less energy available for contraction. Many wrote about a build up of pressure being too much for the heart and causing a heart attack.

(d) Almost all candidates identified the fact that plaque could occur anywhere along the coronary arteries and so gained the mark.

2804 Central concepts

General Comments

Examiners felt that there was a general lack of ability to analyse a question and reason out logically what was happening in detail. The ability to describe and interpret experimental data was weaker than in previous sessions. Many candidates seemed unable to follow a logical progression of ideas and processes. Many marks were lost because the wording of the answer was not precise enough. One of the growing problems is the more frequent use of 'it' and 'they' in candidates' answers rather than specifically mentioning the examples given in the stem of the question. This makes many sentences ambiguous, as it is not clear exactly what 'it 'and 'they' refer to. On the credit side examiners felt there was a marked improvement in the candidates' ability to calculate a percentage change as in Q 5 (b) (ii). As on previous papers it is the A02 marks that are more difficult for the candidates to score. Applying their knowledge to unfamiliar material remains a considerable weakness.

Comments on Individual Questions

Q1 This was a fairly straightforward question at the start of the paper and, by and large, candidates handled it well and scored quite highly.

(a) Most candidates coped well with this section. They were clearly helped by the letters on the graph and answers were well organised as a result. Nearly all named the different phases to gain the QWC mark, although some confused log/lag. Most candidates described the graph in sequence, and commented on each phase. Marks were not gained by purely descriptive accounts, however, and quite a few candidates failed to gain credit as a result. They often referred simply to 'numbers of bacteria rising or falling' or to 'growth' in a vague way in the mistaken belief that these embraced an explanation of reproduction or cell division. Some, inappropriately, discussed mitosis. It was pleasing to note, however, that many fully understood the events underpinning the lag phase and then went on to make very sensible points about the role of limiting factors in later phases.

(b) (i) Many candidates had learnt this well and gave answers that reflected good understanding. A sizeable minority, however, either omitted the 'maximum' idea or referred to 'organisms' in general and then failed to gain the mark.

(ii) Few candidates had difficulty here, although some seemed to forget the question context of 'limpets' and gave 'nesting sites' as an option.

Teaching tip
Ensure candidates fully understand the differences in demand between 'describe' and 'explain' questions as used in section (a). Encourage candidates to fully appreciate the question context before giving their answers.

Q2 Examiners felt that the candidates' understanding of the lac operon was much improved from the last time this topic was examined on Central Concepts.

(a) **(i)** Candidates who understood the term macromolecule generally gained the mark by stating protein or glycoprotein.

(ii) Examiners were pleased to see many accurate explanations of what happens to the repressor molecule. Credit was given for stating that it binds with the lactose and that this alters its shape. The repressor is then unable to bind to the operator or it detaches from the operator.

(iii) Most candidates correctly identified the section of the operon to which the repressor binds as the operator.

(b) **(i)** Examiners were looking were looking for a reference to the observable characteristics of an organism as a definition of the term phenotype.

(ii) Examiners were looking for candidates to go through the process of protein synthesis stating how an altered DNA sequence will result in altered messenger RNA and following translation an altered amino acid sequence of the repressor protein. This will result in the repressor having a different shape, preventing it from binding at the operator. This allows RNA polymerase to bind at the promoter and transcription of the structural genes will take place.

(c) The sex linked genetics problem was well answered by many candidates. It is pleasing to see that the vast majority of candidates used the symbols given in the stem of the question. The most common error was individual nine who was often incorrectly identified as homozygous dominant rather than heterozygous. Examiners felt that perhaps candidates were unfamiliar with the possibility of mutant alleles being dominant.

(d) Examiners were looking for the fact that with an altered protein carrier phosphate would no longer be reabsorbed from the glomerular filtrate, and that concentrations of phosphate ions in the blood would drop. This would result in less phosphate being absorbed into bone tissue. There were many very muddled answers with candidates having clearly not read the question carefully enough and referring to phosphate carriers in the blood.

Teaching tip
Encourage candidates to learn simple definitions carefully. There were many poor definitions of phenotype in this question and carrying capacity in question 1. The booklet 'Biological Nomenclature' published by the Institute of Biology [ISBN 0-900490-36-5] provides very clear guidance on how to define key biological terms.

Q3 This question was surprisingly poorly done by a large number of candidates. Many failed to make use of the information provided in Figs 3.1 and 3.2. Centres should stress to candidates that all the information provided as stimulus material in the stem of the question is potentially useful when answering the sections of the question. This information can be in the form of text, diagrams or data.

(a) Examiners were looking for the term apical dominance.

(b) This question required the candidates to study Fig. 3.2 carefully and then describe the effects of IAA and GA on lateral bud development in potato plants. No prior knowledge of potato plants was required to answer the question. Weak candidates saw the question as an opportunity to write all they knew about IAA and GA often referring to tropisms and germination and failed to score marks. No explanation for the effects shown in Fig. 3.2 was expected and there was no credit given for anything other than a description in the mark scheme.

(c) (i) Examiners were pleased to see eukaryotic, hyphae and cell walls made of chitin correctly stated by many candidates. Heterotrophic, reproduction by spores and glycogen food stores were also commonly seen and credited.

(ii) Lack of clarity in this section cost many candidates valuable marks. Examiners were hoping that candidates might have looked at Fig. 3.1 before attempting this question. The flowers on the diagram were present to cue them in to sexual reproduction in Angiosperms and examiners were hoping to see some detail of how selected plants might have been crossed ie through manual pollination. There were few candidates who stated that the seeds from a cross would be planted and that the offspring would be observed for the selected traits. Many candidates incorrectly interpreted the question as a chance to write an account of genetic engineering rather than artificial selection.

(iii) Few candidates appreciated the role of tubers in vegetative propagation even though it is clearly shown in Fig. 3.1. Examiners also credited references to taking cuttings or tissue culture.

Teaching tip
When covering artificial selection [Learning outcome 5.4.5 (l)] include examples from both the animal and plant kingdoms.

Q4 Examiners reported reading a pleasing number of excellent answers showing evidence of good teaching and learning.

(a) Candidates often scored at least 3 marks out of 4. The common mistakes were ‘2’ for part (iv) (confusing net with total) and occasionally triose phosphate for part (iii). The question clearly asks for the name of the 3C compound that will enter the mitochondrion and this is pyruvate not triose phosphate.

(b) This question produced a wide range of marks. Apart from weaker candidates who often wrote little or nothing, a pattern soon emerged whereby knowledgeable candidates could be grouped into:

- those who wrote confidently well structures answers that could have scored well above the maximum mark,
- those who failed to read the question carefully and wrote detailed descriptions of the Krebs cycle and oxidative phosphorylation.

The question directed candidates to describe the *role* and *fate* of reduced NAD in *yeast* cells in *two* situations. Although a large space was available for candidates to respond, it should have been fairly straightforward for them to recognise that the question could be divided up into several parts and that they could similarly divide their answer up. Unfortunately, few candidates did this, which led to many rambling accounts, often very far from the point of the question. Perhaps candidates thought they were simply being asked to describe the whole process of respiration, or maybe they believed that by writing everything they knew about the process, they were bound to pick up the marks. Whichever the case there were often whole paragraphs which drew not a single mark as candidates recounted their complete knowledge of the electron transfer chain and chemiosmosis. Had these candidates recognised that the question was only about NAD_{red}, then they might have focused their response much more effectively

(c) Few candidates collected all three marks, here, although most were awarded one or two. The lack of decarboxylation in lactate production and the one-step, rather than two, were most commonly awarded. The different enzyme along with the reversibility of lactate production was less frequently awarded but by no means uncommon. Weaker candidates sometimes referred to “lactic acid being converted to lactate”.

Teaching tip
Candidates should be encouraged to read questions twice before attempting to answer. Section (c) was asking candidates to compare two biochemical pathways. Points of difference need to be described more clearly. A tabulated answer might help to clarify the candidate’s response.

Q5 Examiners saw a lot of pleasing answers to this question where candidates revealed a very sound overall grasp of the control of blood sugar levels in mammals.

(a) This was well done on the whole with most candidates gaining three marks or more. Many candidates would have fared better had they been taught about the structure of scientific terms – their components. For example, that the word ‘lysis’ means split, and ‘genesis’ means synthesis.

(b) (i) Most candidates managed to read the correct values off the graph but a number only gained one mark because they failed to round up their calculated figure to the nearest whole number.

(ii) Examiners reported that many A grade the candidates failed to get full marks on this section. In general candidates did not think in enough detail. If they started their answer with blood glucose levels rising and this resulting in the secretion of insulin they were generally more successful. Weak candidates simply **described** the changes in activity of the enzymes shown on Fig. 5.2 whereas the better answers offered creditable **explanations** for the changes. With glycogen synthetase, increased enzyme activity needed to be linked to the increased production of the enzyme, leading to the conversion of glucose to glycogen. Similarly, good candidates referred to glycogen phosphorylase production decreasing as there is little requirement for glycogenolysis to occur.

(c) Most candidates correctly named the endocrine tissue as islets of Langerhans and the cells that produce insulin as beta cells.

(d) Many candidates correctly identified the location of the insulin receptors as the cell surface membrane and the chemical structure of these receptors as protein or

glycoprotein. Many candidates understand that when insulin binds to the receptors it increases the permeability of the cell to glucose and that the activity of glycogen synthetase is increased leading to the production of glycogen from glucose.

(e) Candidates could use the information in the stem of the question to answer this section. Many correctly stated that the number of insulin receptors decreases and that the target cells become insensitive to insulin. Credit was also given to candidates who stated that insulin will continue to be produced in obese individuals.

Teaching tip
When using complex biological terms such as gluconeogenesis and glycogenolysis explain the derivation of these words to students.

Q6 A demanding question to finish the paper. Examiners reported that it was clear from the many weak answers that candidates do not understand the concept of the net rate of photosynthesis. Hence candidates had difficulty in describing Fig. 6.1.

(a) **(i)** Most candidates could define the term limiting factor as something which reduces the rate of a reaction or named process. Some answered by referring to population size, perhaps relating back to question 1.

(ii) Successful candidates related their answers to the effect of stomatal closure on reducing CO_2 diffusion. Credit was given to candidates who linked stomatal closure to the production of ABA in the leaves.

(b) This was poorly answered in terms of the langauge used by many candidates. Most appreciated the fact that the rate of photosynthesis in shade plants reaches a plateau as light intensity increases, although it was common to read answers referring to shade plants beginning to photosynthesise 'earlier'. Only the better candidates organised their answer to consider what was happening at low light intensities and then high light intensities. Credit was given to candidates who simply described the graph in terms of shade plants photosynthesising more rapidly at low light intensities and sun plants photosynthesising more rapidly at high light intensities.

(c) **(i)** Most candidates gained credit for referring to fewer cells or less palisade tissue.

(ii) More able candidates explained fully the implications to the plant when the rate of respiration exceeds the rate of photosynthesis. Weaker candidates were confused in trying to relate the amount of oxygen produced in photosynthesis to respiration rate. Examiners found a lot of references to energy being produced in photosynthesis and then used in respiration. Better answers referred to the production of sugars in photosynthesis and the utilisation of these sugars in respiration.

(d) **(i)** Most candidates correctly read the values off the graph and stated the units.

(ii) Candidates gained credit for naming possible adaptations such as movement and location of chloroplasts, leaf size or respiration rate. However it was rare to see full marks scored with very few references to how these adaptations might be controlled through the action of plant growth regulators.

Teaching tip
When teaching limiting factors always discuss the relationship between photosynthesis and respiration. Explain the true and apparent rates of photosynthesis. Describe sun and shade leaves or plants.

2805/01 Growth, Development and Reproduction

General Comments

This paper attracted a wide range of marks between 15 and 89, and there were some blank spaces. Many candidates provided much more information than was required for many questions, which enabled the Examiners to assess and credit their performance effectively. This also demonstrated a good standard of preparation for the paper. The general standard of the answers was good, demonstrating the high quality of many of the candidates sitting this paper.

In those parts of questions which required the recalling of learned information, many candidates scored well. Those areas requiring thought provided many interesting and varied responses, demonstrating to the Examiners that the topics had been well assimilated. However, those parts of questions 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 nervous system in terms of both function and origin. This can be particularly effective in sections where links needs 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.

Attention is also drawn to the mathematical requirements on page 113 of this specification.

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

Teaching tip
Candidates should be aware that when questions are worded to include ‘using the data from Fig. 1.1’ etc., credit will be given for inclusion of data, with appropriate units, from the figure. Candidates should practise interpreting graphs and tables. They should also practice identifying the ‘trend’ and quoting data to support their interpretation.

Comments on Individual Questions

Q1 Many candidates found this question challenging, particularly sections (b) and (c)(i) However section (d) provided many pleasing and thoughtful responses.

(a) Most candidates were able to gain marks in this section, and were able to correctly identify the kingdoms Plantae, Prokaryotae (or protoctista) and fungi / plantae.

(b) Surprisingly, many candidates found this difficult and few scored both available marks. Some candidates correctly quoted locomotion, and having no cell walls as being characteristic of the Kingdom Animalia, and some also gained credit for describing them as heterotrophic.
A wide variety of incorrect suggestions based on the general characteristics of living things were given by many candidates, such as being able to reproduce, able to carry out respiration etc.

(c) **(i)** Hydra was by far the most popular choice, although some candidates gave other responses which were credited, such as jellyfish and the ribbon worm. Surprisingly there were quite a few blank spaces.

(ii) Similarly, many candidates left this section blank. Credit was given for descriptions of different types of asexual reproduction. Budding was usually described, although few candidates were able to give full descriptions to gain all of the available marks. Those candidates who chose to describe other methods, such as fragmentation, were often able to gain credit for noting that mitosis is involved, and that the offspring produced are genetically identical to the parent.

The vast majority of candidates answered this section very well, and were able to correctly state two advantages of asexual reproduction.

(d) It was very pleasing to note that most candidates were able to assimilate the information given in order to produce thoughtful responses to both parts of this question.

(i) Many candidates correctly realised that unless the nucleus was removed from the oocyte, there would be too many chromosomes in the resulting cell. Others also noted that it was the genetic information from sheep A which was required.

(ii) Some candidates suggested that the *oocyte is ready to divide* in order to form a new organism, whereas a body cell is not. Leading on from this, some unfortunately stated that the oocyte is *unspecialised.* The other most common mistakes were first, the failure to realise that the oocyte has had the nucleus removed and to comment upon the genetic information it contained , or to assume that the oocyte was then going on to be fertilised in some way. No reference was made to the nutrients stored in the oocyte.

Q2 Much of this question required straightforward recall. Those candidates who were well prepared, and there were several, scored well. The answers to this question suggest that many candidates had a good understanding of these topics.

(a) Many well prepared candidates gained maximum marks for this section as they displayed good knowledge of both the stages in the production of pollen grains and the importance of both meiosis and mitosis. Other candidates were confused between the production of pollen and the production of the female gamete, and consequently gained few marks.

Further confusion existed about exactly when mitosis occurred in the pollen sacs, many believing the pollen grains (from the tetrad) then go on to divide by mitosis to form many pollen grains.

(b) This section required the candidate to make use of the photographs of O. biennis flowers and pollen as the question began 'Using Fig. 2.1 and Fig. 2.2.' Most candidates correctly identified features of the flower which would favour insect pollination such as bright colours, landing platforms etc., but it was surprising that few candidates referred to the appearance of the flower in UV light. Very few identified or made reference to the honey guides.
Similarly, the visible features of the pollen were largely ignored although a few noted that the pollen was rough and therefore would stick to the insects back. Only a very few commented upon the pollen sticking together in a string.
Features such as the scent of O. biennis were not credited as these could not be observed on the Figs. Nevertheless, many maximum marks were awarded here.

(c) This question was answered well on the vast majority of examination papers.

(i)The term *dioecious*, or a close approximation, was correctly given by most candidates. The most common incorrect response was *monoecious* as might be expected.

(ii) Again, most candidates were able to suggest a disadvantage to a plant having separate male and female plants; the problem of plants being widely separated or relying upon pollinators was often discussed, along with the fact that self pollination is impossible.
Occasionally a candidate would fail to gain marks by suggesting an advantage, rather than a disadvantage.

(iii) *Protandry* and *protogyny* were usually named as other mechanisms to favour cross pollination. *Self incompatibility* was occasionally given. Most candidates gained credit in this section.

(d) There were many pleasing explanations as to why variation is important for selection.
Most candidates gained some credit for reference to plants adapting to changes in the environment. Some went on to say that these better adapted individuals would survive to reproduce and therefore pass on these adaptations to their offspring.
Some candidates made good reference to natural selection, survival of the fittest, and explained their answers in genetic terms.

Q3 Overall, candidates scored quite well on this question. Again those who were well prepared gained marks easily and there were many good and detailed answers.

(a) Most candidates gave detailed descriptions of capacitation. Most correctly described the removal of glycoproteins and plasma proteins, but some were uncertain about the location of these. Many described the effect of these actions upon the sperm.

The most common error was to describe the acrosome reaction.

(b) Many detailed descriptions were seen of the mitochondria in the sperm.
Many candidates described both the function of and the location of the mitochondria in the sperm and gained credit. Most candidates were able to gain all three available marks, The section on the acrosome was answered less well, although many candidates were still able to gain maximum marks for the section.

Some candidates were able to state that the acrosome enzymes digest a pathway for the sperm, but some were unable to specify through the follicle cells or zona pellucida.

(c) This section was generally well answered. Most candidates were able to offer intelligent suggestions where relevant, and there were very few blank spaces. It should be noted that in questions involving the female reproductive system, credit will generally only be given for use of the correct terminology. Where appropriate, the terms primary oocyte, secondary oocyte, ovum should be used rather than the colloquial term 'egg'.

(i) As a cause of blocked or damaged oviducts, many candidates cited scar tissue, sterilisation or ectopic pregnancy, and gained credit. The most common reason for missing the mark was due to vague statements such as cancer, or infection.

(ii) Approximately 75% of candidates gained this mark by discussing the need to prevent ovulation or the secretion of hormones. The other 25% mistakenly assumed the treatment was to cause the production of several oocytes, and so failed to gain this mark.

(iii) Nearly all candidates gained credit by explaining that the procedure could cause harm to one of the reproductive organs.

(iv) Many candidates realised that an advantage of introducing more than one embryo into the uterus is that it increased the chances of one of them implanting. Some failed to gain credit by stating that more than one might be fertilised. Most candidates stated that a multiple pregnancy was a disadvantage, but most failed to say why and therefore did not score the mark. A simple statement such as multiple pregnancy is a risk' would have sufficed. It was hoped that candidates would talk about the risks to both the mother or the embryos.

(d) This section specifically required candidates to make use of the data in the figure. It was very pleasing to note that most candidates quoted figures from the graph, complete with units, to illustrate their answers. Consequently, many marks were awarded for their descriptions.
Most candidates gained credit for correctly stating the trend that as age increases, the percentage of both pregnancies and live births decreases. Credit was given for any intelligent comment upon the data and some candidates gained further marks by noticing other factors, and for relating these to the problems faced when using IVF. Candidates fared less well when asked to explain these trends. Many made correct reference to the menopause causing problems with becoming pregnant, or to hormone imbalance in later life. However, there were few other suggestions e.g. those which involved implantation, fertilisation or miscarriage.
It is necessary to address both the description and the explanation to score full marks on questions of this type.

Teaching tip

Candidates should learn the difference between 'describe' and 'explain' as explained in the glossary on Page 117 of the specification. They could then practise answers to questions of this type.

Q4 This question was not answered well in general. The insert showing part of the root tip was used reasonably well, but few marks were gained overall.

(a) **(i)** Only very few candidates were able to do the calculation.

(ii) When asked to describe how changes in cell size occur, with reference to the insert showing the L.S. of Lilium root tip, only the most able candidates were able to gain all three marks available. Several candidates gained no marks, whilst some only gained one for correctly describing the three zones, A, B and C as seen on the inset. Some candidates correctly stated that cells take up water by osmosis, and some that synthesis of new materials takes place, but rarely were all three points seen together. Very few descriptions made reference to the cell vacuole or to plant growth regulators. The Examiners had hoped that the description of how the changes occurred might have included reference to stretching due to the influence of a plant growth regulator and the entry of water by osmosis.

(b) **(i)** In response to this question, candidates tended to either discuss the breaking of bonds in sucrose by hydrolysis, thus gaining some marks, or discussed the role of the sucrase enzyme, making reference to the active site, enzyme-substrate complex etc. Few candidates included both approaches in their answers for this question which was synoptic covering enzyme action from Foundation 5.1.3. Only the more able candidates gained the marks here, many candidates gained one or none. Failure to gain credit being due often to vague unspecific descriptions of enzyme activity.

(ii) Most candidates gained no marks for this section. Most incorrectly assumed that the hydrogen ion formed part of the water given off in the (hydrolysis) reaction. A rare few correctly suggested that it might affect the pH, or be involved in co-transport.

(iii) The role of glucose and fructose in respiration, or the provision of ATP (energy), was the most common function stated and many candidates went on to say that this energy was required for cell division, thus gaining both marks available. A few candidates also discussed their role in drawing in water, through osmosis by decreasing the water potential of the cell. Most candidates were able to gain at least one mark in this section.

Q5 **(a)** The answers to this section were very varied, some candidates scoring well in parts of the table and less well in others.
The function of the *vagina* was usually correctly stated as being the place where sperm are deposited, or where the penis enters, during sexual intercourse.
However the function of the *cervix* often failed to gain credit, as candidates tended to discuss the mucus plug, without relating this to the cervix.
The *endometrium* was almost exclusively mistaken for the *wall of the uterus,* and consequently, the functions relating to implantation etc. were inappropriate.
The function of the oviduct as the site of fertilisation, or the route taken by the *oocyte/ovum/zygote* to the uterus, was often stated here and so gained the available mark.
Many candidates seemed to be unfamiliar with the *fimbriae*, and where an appropriate function was described, candidates often missed gaining the mark by referring to the *ovum* or *egg* rather than the *secondary oocyte*.

(b) Most candidates scored a mark when they correctly described an endocrine organ as one which secretes hormones, or a hormone. A second mark was rarely forthcoming however, apart from the few who knew that the organs secrete directly into the blood, without the use of ducts.
A common inappropriate suggestion was that they are endocrine glands because they *respond* to other hormones.

(c) When describing the changes shown in the lining of the uterus, as shown in Fig. 5.1, candidates fell into two categories; those who were well prepared who gave excellent and detailed descriptions, and those who were not. In the former category, good reference was made to the figure, relating their descriptions to the 'days of the cycle'. The hormones were correctly assigned to their functions in the menstrual cycle, and many marks were gained, including the QWC mark for relevance. The other category of candidates confused the roles of oestrogen and progesterone, and often failed to gain the QWC mark as their accounts were not in the correct context.
In many of those in both categories, marks were often lost due to confusion between the terms *wall* and *lining* of the uterus with many candidates interchanging the terms as though they referred to the same structure.

(d) This section was not answered well at all. Many left this section blank; many described nutrients with reference to other than the menstrual cycle, e.g. *calcium, to make bones in the foetus,* or *carbohydrates for energy.* Several candidates however gained marks for stating that iron is required in order to make haemoglobin. This was the most common correct answer.

Q6 Many candidates were unable to gain many marks in this question. Parts were answered well, but those sections requiring more thought were answered less well. In many of the sections which referred to fruit ripening, this was ignored by many who answered in terms of dormancy, and often referred to *the seed.*

(a) Very many candidates gained marks by observing that the tomato has seeds and is therefore a fruit.

(b) When asked to name the parts of the flower which developed into structures X, Y and Z, many candidates mistakenly named the parts of the tomato labelled X, Y and Z. Very few identified X to have derived from the sepal. Several derived Y from the ovary, rather than the ovary *wall*, and thus failed to gain the mark, and some were able to say that Z came from the ovule.

(c) Many candidates left both **(i)** and **(ii)** blank

(i) Some candidates described the role of various external factors, such as temperature, and of PGRs in switching these genes on. No reference was made to either promoter or regulator genes, or to the concept of gene switching. Several candidates mistakenly talked about the role of water in breaking seed dormancy.

(ii) Some candidates correctly inferred that calcium pectate would not be broken down, but few related this to the fact that pectinase would not be made.

(iii) Many candidates gained at least one mark for suggesting other ways of slowing the ripening of tomatoes. The favoured techniques were keeping them cold, or keeping them in an oxygen free environment. Candidates who did not have the knowledge were still able to gain credit by inferring that inhibiting gene P would have the same effect.

(iv) This section was generally answered well. Marks were often gained by suggesting that tomatoes could be kept in storage or in transit for longer if ripening was delayed. Several candidates incorrectly stated that ripe tomatoes could be produced *at any time of year.*

(d) This section was often left blank, perhaps because it was the very end of the paper. Only a very few candidates made any mention of abscission or of the role of abscissic acid in fruit fall. Some gained credit by detailing the roles of cytokinins in slowing ageing and to that of ethene in promoting ageing, but references to fruit fall were rare. This suggests that despite the fact that the stem directed them to the synoptic topic of leaf fall (5.4.6 (s)), candidates were unable to apply this knowledge in the context of fruit fall.

2805/02 Applications of Genetics

General Comments

Some candidates had been well prepared for this paper, showing good knowledge and understanding of the topics tested in this option. These candidates were able to use that knowledge when presented with unfamiliar situations and data.

As in previous years, many of the questions that included synoptic material, which make up 25% of the total marks, were answered less well than those on topics exclusive to this option. Most candidates answered all parts of all questions but a significant number left sections of questions blank. These sections were scattered throughout the paper suggesting that the problem was lack of information rather than lack of time. All questions allowed discrimination between candidates, with marks spread over a wide range.

Technical terms were mostly used correctly, but candidates who confuse the terms *gene* and *allele*, *homologous* and *homozygous*, or *chiasma* and *crossing over* in a genetics paper put marks at risk.

Comments on Individual Questions

Q1 Many candidates found this to be an approachable first question and scored full marks with their genetic diagrams.

(a) (i) Many candidates recognised the effect of allele **B** on allele **A** as epistasis and applied the terms *epistatic* and *hypostatic* correctly. Stronger candidates went on to describe the effect in terms of blocking transcription or translation.

(a) (ii) A pleasing number of candidates were able to produce a correct genetic diagram here. Some candidates failed to relate genotypes to phenotypes, particularly for the F_2 generation. Some gave a ratio of 13:3 without mentioning white or red colours. However, a minority of candidates thought that the genotype **AABB**, for example, resulted in gametes **AA** and **BB**.

(b) (i) A pleasing number of candidates were able to suggest close linkage of a gene giving resistance to 'smudge' with the gene **B**/**b**.

(b) (ii) A surprising number of candidates who identified linkage in (b)(i) failed to continue their train of thought to suggest crossing-over here. Many suggested random mutation instead.

Teaching Tips

Remind candidates to encircle the letters of a gamete. Strings of letters with no punctuation or gaps cannot be interpreted by the reader.
Discourage candidates from writing out crosses involving more than one identical gamete from a homozygote.
Remind candidates that the dominant allele should precede the recessive in a heterozygous genotype (**AaBb** not **aAbB**).
Encourage candidates, when producing a Punnett square for a dihybrid cross, always to put the gametes in the sequence **AB**, **Ab**, **aB** and **ab**. They will become familiar with the pattern of offspring genotypes produced and will be more likely to spot an error.

Q2 Despite answering the questions on heritabilty in section (a) well, a surprisingly large number of candidates failed to carry forward the idea of phenotypic variation being the result of both genotype and environment into section (b).

(a) (i) For a pleasing number of candidates *heritability* is the proportion of phenotypic variation that is due to the genotype, but some wrongly interpret it as the likelihood of an individual inheriting a trait from its parents.

(a) (ii) This section was answered well. '*One cannot select for variation due to the environment*' and '*successful selective breeding requires high heritability*' were two common correct ideas.

(a) (iii) Some candidates failed to note that the examples were of human illnesses and wrote in terms of selective breeding. Many candidates made useful reference to the examples given, but some thought that the values related to the chance of 'passing on' the condition.

(b) A surprisingly large number of candidates seem to have decided that the four leaves shown in the diagram were samples from a population. They then wrote about the differences between continuous and discontinuous variation. A smaller number thought that they were the result of crosses and wrote about inbreeding and outbreeding.

The mark for the quality and use of scientific terms required a clear description of the involvement of both genotype and environment in phenotypic variation with appropriate use of terms such as *variation* or *variance*, *phenotype*, *genotype*, *environment*, *heritability* and $V_P = V_G + V_E$.

Teaching Tips

Remind candidates that the information given in a question is there for a purpose and to take note of the labels in a diagram.

Q3 It is often the case in option papers that questions involving synoptic material are answered less well than other questions, but it was surprising to find poor responses when the synoptic topics were respiration and enzymes.

(a) Many candidates were able to answer that this prevented self-pollination, enabled a desired cross to be made or that it saved having to remove the stamens.

(b) Only a few candidates were unable to invoke a restriction enzyme and sticky ends to form recombinant DNA. Several candidates scored full marks here.

(c) The stronger candidates stated that putting the foreign gene into a chloroplast was less likely to disrupt a nuclear gene or that the chloroplast was self-replicating, increasing the number of copies of the transgene.

(d) It was difficult to believe that many candidates had any knowledge of the role of acetyl CoA in respiration. Several candidates referred to the Calvin cycle rather than to the Kreb's cycle. '*It will be broken down into ATP*'. was the commonest response.

(e) Stronger candidates gained marks for higher concentrations of E2 than E!, for active sites with a better fit or greater affinity, or for a faster turn-over number. Weaker candidates thought that E2 bound with E! rather than with acetyl CoA. Several candidates wrote about an active site of the acetyl CoA.

Teaching Tips

Remind candidates that 25% of the marks on an Option paper are synoptic, and that the material concerned may come from any part of the AS specification or A2 core specification.

Q4 Many candidates appreciated the need for gene banks and understood how plants are cloned from tissue culture and how seeds are banked.

(a) This procedure was well known, although very few candidates referred to the need for pluripotent / meristematic cells in the initial explant. Candidates were happier with the growth and subdivision of callus and the production of plantlets.

(b) A pleasing number of candidates recognised that this was to maintain genetic variation, although ways of expressing that idea varied.

(c) Such a population was not always recognised as a gene bank. Many candidates wrote that the population was needed for future breeding or, more rarely, for genetic engineering. Some candidates lost marks because although they identified a potential need, such as climate change, they did not say that the trees might have traits that would be desirable in the changed circumstances. Confused statements about extinction emerged. If the pine population became extinct it would not be there to cure the problem.

(d) Many candidates answered that this would reveal what conditions were tolerated by the plants. A few realised that this could show any genetic variation that already existed. Very few candidates saw that the optimum conditions for growth might be identified. A few candidates, having presumably read ahead to (e) answered this section in terms of growing seeds.

(e) Both the maintenance and use of seed banks were well known. A pleasing number of candidates scored full marks.

Teaching Tips

Remind candidates that when talking about gene banks one is likely to be trying to maintain *genetic* variation and thence *phenotypic* variation, not unspecified variation and not biodiversity.

Q5 Many candidates were able to identify Down's syndrome from the chromosomes shown and to give both advantages and disadvantages of such genetic screening.

(a) (i) The majority of candidates correctly identified Down's syndrome from the trisomy 21 shown in the diagram. Other suggestions included cystic fibrosis, Huntington's disease and haemophilia (carried on the Y chromosome shown).

(ii) Several candidates failed to take note of the phrase: '*With reference to Fig. 5.1*' and wasted time and space describing translocation of the long arm of chromosome 21 onto another autosome, which is not shown. Some of the candidates choosing, say, Huntington's disease in (a)(i) still described trisomy 21 here.

(b) (i) Some very good answers to this question were seen, with excellent examples of both advantages and disadvantages. Weaker candidates tended to write at length about a few points, adding nothing to their argument with the extra lines. Some candidates lost marks by saying that the testing gave parents a choice of what to do, without saying what it was that they might do.
The mark for quality of spelling, punctuation and grammar was awarded to a majority of the candidates. Some candidates lost this mark though using phrases rather than full sentences.

Teaching Tips

Point out to candidates that in an answer involving extended writing it is possible to use bullet points, or to divide the page into a table, provided that each bullet point, or entry in a table, is a full sentence.

Q6 A few candidates seemd to know nothing about the problem of compatibility of transplanted organs other than to say that they might be rejected.

(a) Some very good answers were seen to this question. Errors included thinking that the HLA alleles controlled blood type. Some candidates thought that it was the alleles, displayed on the cell surface, that were rejected. Some confused antibodies with antigens.

(b) (i) This section was answered well by a majority of candidates. The commonest valid points made were that the urea concentration began falling as soon as the treatment started. that it fell to that of normal rats (the rats became mice in one answer), and that the concentration rose again as soon as the treatment stopped.

(b) (ii) Some candidates failed to draw a line onto the graph. Others drew a line for normal rats, starting from day 0, rather than for experimental rats at day 10. Only a small number of candidates drew a line rising from day 10 to day 40.

(b) (iii) Many candidates scored both marks here, recognising that the concentration of toxic ammonia would rise. Some candidates lost a potential mark for changing the pH by confusing the direction of change, saying that an increased concentration of carbon dioxide raised the pH or increased ammonia lowered it.

(b) (iv) The most common mark-worthy answers concerned the danger of passing the transgene to other bacteria via horizontal transmission. Other potentially good points were wasted here from lack of precision, such as problems that plainly needed the bacteria to escape from their capsules, but this was not stated. Suggestions that '*The transgene might affect human genes with unforeseen consequences*' left a lot unsaid.

Teaching Tips

Remind candidates to look carefully at the scales on graphs and always to use units when quoting from numerical data.

Ask candidates to try very hard not to be vague. Many of their suggestions are likely to be mark-worthy, provided the reader knows exactly what they mean.

2805/03 Environmental Biology

General Comments

Overall the candidates performed well in the paper with many scoring well on all questions. Candidates were able to answer parts of each question set and there was not one area that was poorly attempted.
Both long response questions were found difficult by weaker candidates and many found it difficult to get the QWC mark for use of technical terms.
Recall from AS and central concepts units was generally good and there was a considerable improvement on previous years.
For the questions involving the use of tabulated data, candidates performed well and used the data accurately and appropriately. Candidates struggled with the data presented in question 2 and many weaker students misread the information on the axes.
Once again candidates performed poorly when answering questions based on practical knowledge.

Comments on Individual Questions

Q1 **(a) (i) & (ii)** Candidates were not troubled with this first question with most clearly identifying a decrease in forest cover for Brazil and an increase in cover for Rwanda. Many candidates used data to illustrate their answer and most were able to correctly calculate percentage area forested for Brazil in 2005.

(b) Most candidates were able to state at least two environmental problems of deforestation. It was a shame to see so many candidates citing a major problem of deforestation as being that of a lack of atmospheric oxygen being produced. The problems of soil erosion were explained by many and also a link to flooding and river silting was given credit for.

(c) This part of the question involved the candidates being able to evaluate and make a judgement on the data given in Table 1.1. There were many possible answers to this question but primarily it was down to differences in the actual forested area for each country and the size of that country. It is fair to assume that the impacts of deforestation would be greater for Malaysia as with a smaller overall area of forest any impacts will be more greatly felt than for a country such as Brazil that has such a substantial forested area.

(d) This part of the question involved candidates linking AS knowledge together to suggest why species removal and the consequences of deforestation might be difficult to predict. This proved difficult for most candidates to score full marks although there were many good answers given explaining the complexity of food webs and how many species may simply switch diets and so any effects may be difficult to assess.

(e) (i) & (ii) Most candidates could state that a carbon sink was something that absorbed and used carbon for a particular process. Most candidates were confused by the direction of the second part of question e and simply reworded the question. Those few candidates who scored full marks here simply used some AS, central concepts or even GCSE knowledge of photosynthesis and suggested that the plants would have a different rate of growth, altered level of productivity and linked this to the storage of carbon. Some candidates went on to link oil palms to increased stores of oils and related this to hydrocarbon chains and were credited accordingly.

Teaching tip
Candidates did not really seem to struggle with the concepts of deforestation but found it difficult to use data and link this to other areas of the specification – notably the topics on ecosystems and also photosynthesis.
The following site http://news.mongabay.com/2005/1115-forests.html provides a huge amount of detailed material on deforestation that can be used as data analysis tasks and also as case studies. Part of question 1(d) involves predicting how loss of species might affect other species in a food web. The removal of keystone species is of particular interest here, in rainforest regions but also in many other complex ecosystems. The following site, http://www.snh.org.uk/pdfs/education/biodiversity/3%20keystone%20species.pdf provides some excellent stimulus material for students.

Q2 **(a)** This first part of question 2 involved candidates describing the overall pattern of phytoplankton distribution. This was well done with many candidates scoring full marks here. It was pleasing to see so many candidates describing a fluctuating pattern but with an overall increase in colour intensity.

(b) (i) & (ii) For parts (i) and (ii), it was really important that candidates understood what phytoplankton were. It was evident from some of the responses that the terms *primary source of food* did not clue candidates onto the idea that the question was talking about marine plants. As a result, part (i) was not done well and all candidates had to do was link seasonality to increased light or temperature for the reactions in photosynthesis. There were very few other answers that candidates gave to explain variation in colour intensity.
Part (ii) involved no explanation but a comparison of 2 sets of data was required for the correct answer. It was clear from some candidate responses that many did not read the question carefully.

(c) Candidates gave some very good answers and many linked increases in temperature to kinetic energy of enzymes and subsequent chlorophyll production. Those candidates who failed to realise what phytoplankton were did not do well here.

(d)(i) & (ii) Most candidates were not troubled here and only weaker students failed to define *abiotic*. Most candidates went onto cite predation as the biotic factor and linked this to the effects on the populations of phytoplankton. Very few described a resource and linked this to the growth of these plants.

(e) This was the first longer response questions of the paper and candidates produced very mixed answers. It is fair to say that very few offered a satisfactory description and explanation for the full 5 marks. Many responses linked the use of CFC's and the destruction of the ozone layer to the problems of global climate change – obviously getting confused and missing the point of the question! There were very few explanations of how increased levels of carbon dioxide, methane, nitrous oxide, CFC's and water vapour affect the trapping of long-wave radiation and re-direct it back to earth, hence increasing the warming effect.

Teaching tip

This question was interesting as it tested many aspects of the specification and had several synoptic links. The responses from candidates suggested that there are many weak areas of understanding on the topic of climate change. The following site, http://www.epa.gov/climatechange/kids/greenhouse.html offers a detailed yet very accessible introduction to global warming and http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/ is an excellent whiteboard resource to show students how the Greenhouse effect works.

Q3 **(a)** Candidates were able to link the term neurotoxic to an area of the body that had something to do with the nervous system. There were also some very good suggestions on how the organophosphates might affect the synapse connections.

(b) This question was quite tricky for candidates to score full marks but there were some excellent answers given by many. Candidates still describe insects as having an immunity to pesticides which is scientifically wrong even though the students were probably describing resistance. Immunity is a specific reference to something that is blood borne and pesticide resistance is something that has a genetic basis to it and is a result of survival and then rapid reproduction.

(c) In the first long answer question, good candidates scored highly here. Weaker candidates failed to split the essay up into two sections. There were marks here for how you would set up and establish the biological control and then further marks for how you would have evaluated the success of the programme. This was fairly straightforward but it was obvious that for many centres the teaching of biological pest control was not detailed. To evaluate the success of the programme, candidates could have either chosen to sample the populations of armyworm or looked at the effect on the golf green before or after the treatment. There were many very good descriptions of the mark-release-recapture technique for monitoring pest populations but unfortunately for some candidates this description took up the whole essay. Of all the papers marked in this exam session, only one candidate completed a plan for this essay. It might be worth stressing for future candidates that any essays that have more than one command word in the stem really need careful planning prior to completion.

Teaching tip

This question centres upon the topic of biological pest control and there is an excellent chapter in the IOB book 'Pest Control' by H.F.van Emden on this aspect of biology. Furthermore, the following site, http://www.defenders.co.uk/ is a brilliant site for introducing students to some of the key biological control agents that can be used and how they are applied and how success can be monitored.

Q4 **(a)** Most candidates correctly identified that the method for assessment of water quality was qualitative, quick and easy but not accurate enough and also not capable of looking at *invisible* pollutants which might be more of a pollution problem than surface litter.

(b) Many candidates struggled here to firstly identify 2 abiotic factors and then to explain why these might be measured to assess the quality of the water. The common answers candidates gave involved oxygen and nitrate concentration and pH with very few others being mentioned. If candidates had not completed any environmental monitoring during field work studies then they would have struggled with this question.

(c) The change in water colour and the link to eutrophication linked many candidates to green coloured algal blooms and excessive plant growth and many discussed the blanketing of the surface of waterways.

(d) This question on indicator species and assessment of pollution was done very well by most candidates and this is an area that is seemingly taught in detail at most centres. Most candidates could name an indicator species and describe its presence or absence with respect to a pollution incident. It was pleasing to see candidates using a real range of species which suggested that either much research into this topic had been done or that many centres had studied this area of environmental biology during fieldwork.

(e) Candidates of all abilities did well on the longer response question on acidification. It was important that they named the gases and then explained their effects and most candidates were able to do this. There were several examples of sloppy usage of terms with quite a lot of candidates describing how sulphur and nitrogen are released from cars and factories. The effects of acidification on aquatic ecosystems have been well taught and most candidates described many effects from disruption to salmon to the damage to fish gills. Overall this was well done.

Teaching tip

The following site, http://www.riverlee.org.uk/watqua/watqua.htm offers a very student friendly approach to assessing water quality and http://www.water-pollution.org.uk/causes.html provides a very nice introduction to all areas of water pollution causes. It is important for students to measure certain abiotic factors through field work studies and with quite simple and inexpensive materials nitrate, nitrite, pH, temperature and oxygen levels can all be determined.

Q5 **(a)** Candidates seemed to struggle in describing the distribution of scarlet oak and many misread the kite diagram and did not understand what the axes showed. The important aspect of the oak distribution was that no trees were found between 0 – 10m and from 50 – 90m.

(b) There were some very good suggestions as to why the pattern of oak distribution was as shown in figure 5.1. Many described deforested clearings, firebreaks and roads whilst other candidates went on to describe the competition from other species and also possible change in soil structure or pH. The suggestion of light being a reason fro this pattern of distribution was discounted as the transect covers a small area, some 130 meters and if a candidate was to discuss the effect of light and shading then that is really competition for a resource.

(c) & (d) Candidates correctly identified the advantages of using kite diagrams as easy to view distribution or species abundance over other diagrammatic representations. For part d however there was quite a lot of confusion over the differences between belt and line transects. The key differences between the two methods are that belt transects use quadrats to measure abundance and have width whereas line transects record the species that touch the line. There were many responses from candidates of how to carry out such surveys but very little detail regarding why you might choose one method over another.

(e) This long response question involved candidates describing how they would have carried out a structural analysis of soil. Any students who had completed some practical work on this area from the environmental biology specification was fine and produced often very detailed accounts of the methods you would use. Many candidates from lots of different centres had clearly not covered this topic area and the responses from candidates were poor. Very few candidates got 3 technical terms and so it was not common to see the QWC mark being awarded. This is an important area of environmental study and one that needs to be prioritised more by centres.

Teaching tip
The following link http://www.countrysideinfo.co.uk/what_method.htm is an excellent site for fieldwork analysis allowing students and teachers to look at data collected from the field and also to decide how best to investigate a certain problem. That is 'do I use a line transect' or 'do I use a belt transect?'.
Furthermore, http://soil.gsfc.nasa.gov/pvg/psd1.htm is an excellent introduction for teachers to demonstrate the techniques used in soil analysis and with very little specialist equipment or laboratory space candidates can carry out quite detailed procedures and determine soil types and soil quality.

Q6 **(a)** Weaker candidates struggled with the concepts involved in what they were being asked to do here. Many discussed how the land would change and went on to discuss succession and plagioclimaxes. There were some good answers though and typical responses involved the idea of removing the contamination from pesticides or adding nutrients to the soil to improve the situation of poor biodiversity.

(b) Candidates found this question very difficult with many not being able to suggest two economic benefits of creating and maintaining a nature reserve. The most common response was the income generated through ecotourism and entrance fees but very few students suggested a benefit could be the creation of jobs.

(c) This part of question 6, although very relevant to environmental biology, tested the candidates synoptic ability and asked them to use knowledge learned in central concepts. There were many good descriptions of coppicing, fewer descriptions of pollarding and lots of information regarding selective felling. Overall, this was well done by most candidates and their recall of sustainable timber production was good.

(d) In answering this question, candidates needed to read the question carefully and see that it was the steps that central government could take upon local councils to increase recycling. This is not the same as local councils taking steps to ensure individuals recycle more. So, answers typically included league tables, fines for targets not being met, taxes and increases in educational awareness.

(e) The final question on the paper involved the candidates using AS and central concepts knowledge in the overall context of recycling. There were some excellent answers by a few candidates who correctly identified that mulch being mainly composed of the complex polymer cellulose would require specific bacteria to decompose it. Many candidates reworded the question and a lot of responses suggested that the structure of cellulose and the hydrolysis of this molecule was a distant memory.

Teaching tip

The following site, http://www.letsrecycle.com has some excellent resources and information that can be downloaded on many aspects of recycling. It has sections on how central government is taking steps to increase the actions of local councils. Furthermore, sites such as http://www.torbay.gov.uk/twin-bin-scheme.pdf show some of the schemes that local councils are doing to improve their record on recycling. It would be an interesting angle to take by comparing this to other countries across Europe and seeing how the United Kingdom fares.

2805/04 Microbiology and Biotechnology

General Comments

In this option, candidates are often required to approach questions using knowledge and understanding gained from the many overlaps that occur elsewhere within the unit specification. This is in addition to the synoptic elements drawn from Central Concepts and AS. There were many well-prepared candidates, who not only benefited from taking this broader approach, but who had also made good use of previous exams and their mark schemes. These candidates produced excellent answers and were able to score highly in all questions. At the other extreme, there were candidates who did not appear academically ready to take a January A2 examination, leaving numerous sections blank or giving answers that demonstrated a lack of understanding of what was required. These scored consistently low marks in all questions.

On the whole, there was a general improvement from previous sessions in demonstrating knowledge of AS topics and an improvement in the quality of extended answers, with the majority of candidates gaining the QWC for spelling, punctuation and grammar in **Q.2(c)** and, for those who wrote about the correct topic in **Q.4**, gaining the QWC for the quality of use and organisation of scientific terms.

Candidates were less well prepared when answering **Q.5(b)(ii),** which required an understanding of the role of acetylcholinesterase (from Central Concepts). In addition, the majority of candidates were unable to perform the maximum rate calculation in **Q.2(a)(ii)**. **Q.6**, which was printed on the back page of the examination, produced low marks for many candidates and in a minority of cases, was left completely unanswered. It is difficult to say if these candidates ran out of time, as the evidence in the majority of scripts suggests that there was sufficient time to complete the paper. One consideration is that these candidates, who had otherwise scored well throughout the paper, may not have noticed the instruction to turn over and missed the question altogether.

Comments on Individual Questions

Question No

1 A number of candidates gained very high marks for this question, generally only making an error in completing Table 1.1, and demonstrating the skills often required in answering A2 questions. Others were less able to approach this question with confidence, including showing a lack of option and synoptic knowledge.

(a) This question allowed candidates to demonstrate their knowledge of features of microorganisms, as studied in this option module, in addition to microorganisms covered in the AS specification and Central Concepts (classification). The full range of marks obtained for completing the table in Q.1(a)(i) enabled good differentiation to be shown between candidates. The part-completed table was intended to allow stronger candidates to work out the remainder of each row. Well-prepared candidates were able to recall the type of microorganism for *Nitrobacter* and *Plasmodium*, but frequently *Plasmodium* was considered to be a virus. The rest of the row, if correct, still gained credit. There were many incorrect attempts at classifying *Saccharomyces* and *Fusarium* as bacteria, suggesting that some candidates were not able to make the necessary links with the other parts of the option specification. The most difficult boxes to complete correctly appeared to be the possession of a cell wall by *Chlamydomonas* and autotrophic nutrition with *Nitrobacter*. The majority of answers for Q.1(a)(ii) were a long way from text book definitions of autotrophic nutrition and here credit was given for all reasonable attempts that demonstrated sound understanding. Less convincing or totally incorrect answers stated that the organisms obtained their nutrition from others, that the organisms converted inorganic to organic molecules, or that they used or synthesised organic molecules. Main cell wall components were often well known in Q.1(a)(iii) and although chitin was given in error in a number of instances for *Saccharomyces*, it was pleasing that many correctly cited mannan and glucan.

Candidates who understood the reasons for the stages involved in Gram staining were able to score most of the marks available in Q.1(b)(i) and for those knew the structure of *E.* coli maximum marks were frequently gained. A surprising number incorrectly believe that *E. coli* is Gram positive. The most common incorrect response for Student Y, for those candidates who could not explain heat fixing, was to believe that by not passing the smear through a low Bunsen flame contaminating microorganisms would have been able to appear on the slide and give confusing observations. Most candidates took the opportunity in Q.1(b)(ii) to gain three or four marks. Although this was intended to be very straightforward, some scripts only contained a list of apparatus and chemicals while others gave aspects of aseptic technique or only wrote about the consequences of an incident ("*tell the teacher if you have spilt something"*, "*wash your hands if you get any chemical on you"*), indicating that these candidates did not fully understand what was meant by a *risk assessment*. 'Explain ….. the need for risk assessments' appears in learning outcome 5.8.2(c).

Teaching tip

When asked to 'name the organism', candidates should refer to the genus or species name and not to the main descriptive group. For example, 'Name the organism that causes malaria.', would require '*Plasmodium* or *Plasmodium falciparum* etc' but 'Name the type of organism that causes malaria.' would expect 'protoctist' to be given.

2 For many candidates, this question was extremely well attempted, with only Q.2(a)(ii) consistently poorly answered. Whereas Q.2(a) and Q.2(b) required specific knowledge and understanding of penicillin production, Q.2(c) enabled candidates to consider batch and continuous fermentation in a broader context.

The majority of candidates were able to gain the mark in Q.2(a)(i), although there were a few who failed to add anything to the graph and they may well have overlooked this part of the question. The best attempts had plotted the points clearly and correctly and had completed the curve smoothly. This contrasted with blunt pencil and / or sketchy and wobbly attempts and in some cases, curves that dipped down sharply or inclined far too steeply, indicating no attempt to use the given data. In Q.2(a)(ii), the challenge of a maximum rate calculation proved too much for most candidates, with many leaving this part bland and very few gaining both marks. The Examiners were expecting candidates to: use values taken from the *steepest* part of the *penicillin* curve; use values taken from the right-hand axis of the graph; calculate a rate (concentration ÷ time). Credit was given for those who realised how to calculate a rate and had either taken readings from the incorrect axis or who had not used the steepest part of the curve. For some answers, it was not easy to see how the candidate had arrived at the incorrect answer so no marks could be awarded. Candidates coped well with **Q.2(a)(iii)** and there were many who gained maximum marks, with almost all satisfying the request to describe **and** explain. The best answers referred to data (with correct units) from the graph to describe the shape of the curves and linked this with detailed explanations. Some gave minutes instead of hours when taking readings and there were quite a few cases of confusion between penicillin and *Penicillium*.

In **Q.2(b)** credit was given for either point of view as to whether the evidence supported the statement. Most answers were in favour of the statement and generally candidates gave good responses.

The extended answer **Q.2(c)** produced the whole range of marks, with many fluent, clear, concise and well organised accounts covering well beyond the maximum marks available. Some candidates gave well written accounts but failed to gain maximum marks as they did not cover a sufficient range of advantages and disadvantages, choosing instead to write at length about one or two particular points. Others compared penicillin production with mycoprotein production and gave information about the batch fermenter with stirrers and paddles versus the air lift loop fermenter, which was not required. Some re-wrote the information given at the start of the question and gave explanations of what was meant by batch and continuous fermentation. A significant minority missed the point of the question entirely and wrote either about the design of the batch fermenter or the problems when scaling up from the laboratory.

Teaching Tip

When using graphs to answer questions, candidates should be advised to spend time looking carefully at the graph, especially those where both vertical axes are used. They can add any necessary markers, such as arrows from curves pointing to the right or left axis, to avoid using the incorrect axis when taking readings. In addition, using a ruler to draw up / across from the axis line is invaluable in taking accurate readings and will also help the examiner in seeing that the graph is being used correctly.

3 This question required candidates to apply their knowledge and understanding of techniques used in microbiology, with Q.3(d) proving to be more accessible than the other sections.

Many candidates found it difficult to give the correct size conversion in Q.3(a)(i) to prove that the microorganism was not visible under the microscope. The most common mistake was to state that 4 μm was the equivalent of 0.04mm rather than 0.004 mm and in these cases a response that attempted to show a size conversion to justify the need for a microscope was credited with one mark. Stating that 0.1mm was bigger than 1 μm or 4 μm was not considered sufficient to gain credit. Where the stationary phase was correctly identified in Q.3(a)(ii), the explanation that followed usually gained a mark. There were probably as many answers that gave 'lag' as the phase, with the connection not being made between the move away from optimum conditions in the stationary phase and the need to fom resistant endospores.

The majority of candidates gave at least one plausible suggestion in Q.3(b)(i), the most popular answers realising that some microorganism may require nutrients for growth and replication that did not occur in potato tissue. Some responses incorrectly assumed that the microoorganisms had been destroyed by boiling the potato tissue, while in Q.3(b)(ii) the glass bell jars were considered to create anaerobic conditions or were somehow warming up the culture to the correct incubation temperatures. The answer required pertained to the possible contamination of the culture from the exterior, the most popular response, or from the culture to the environment, which was rarely given. All other valid suggestions were credited.

Responses to Q.3(c) were very varied. Many candidates had a clear understanding of the method employed by Koch to identify the disease-causing microorganism and had no problems answering Q.3(c)(i). These correctly grasped the fact that once the link had been made between the mammal that developed the disease and the *colony* from which the inoculated microorganisms had originated, Koch could then proceed to identify the causative organism. There were many answers that were very confused and some candidates may have benefited at this stage from quickly constructing a diagrammatic flow chart to help them sort out their ideas. Some thought that all the separate colonies were composed of different pathogens and would cause a range of diseases in the mammals. Others responses involved measuring zones of inhibition or gave answers that suggested that candidates did not know what 'small mammals' were. Most gained at least one mark in Q.3(c)(ii), knowing that one colony is the result of binary fission / asexual reproduction of one original ancestor cell, and better answers gave the extra detail required to gain the second mark. This was an 'Explain whether .....' question and so the alternative response from some candidates who realised that, if not separated sufficiently, colonies could merge and contain more than one type of cell, was also worthy of credit. Q.3(c)(ii) was well answered by those who concentrated on the advantages of using agar, as simply restating the disadvantages given in the introduction, of using gelatin, was not answering the question. A common error was to suggest that agar did not melt at temperatures above 28^0C, rather than to state that it melted at temperatures much higher than those used to incubate microorgansisms. Another common misconception was that the agar contained nutrients: agar as a medium should not be confused with *nutrient* agar.

Q.3(d) was extremely well done by most candidates and there were many who gained the maximum four marks. Unlike previous sessions where this learning outcome had been tested, almost all candidates realised that a streak plating technique was carried out and gave descriptions that included the detail of the transfer of culture to the Petri dish using the correct aseptic technique. A number made use of the available space to support their answer with one or more diagram(s) and gained some of the available marks from these where there were gaps in their written answer. There were instances of

careless statements, such as 'lift the petri dish at a 45^0 angle'. and 'flame the culture', and some diagrams showed subsequent streaks that did not overlap with previous ones.

Teaching Tip

To help candidates understand and practise size conversions, they could each research the sizes of five different microorganisms and give these sizes correctly in nm, μm and mm. These could be swopped around so that they could be checked by other members of the group and then added to a chart that could be displayed.

4 Q.4 was the extended answer containing a mark for quality of use and organisation of scientific terms. Many candidates were less well prepared for this topic than Q.2(c), writing no more than a short paragraph and generally earning the mark points only for realising that the compressed air delivered oxygen for aerobic respiration / digestion. Hence, proportionately fewer gained the QWC mark. The presentation and wording of the question clearly directed candidates to write about the role of microorganisms in the activated sludge method of secondary aerobic treatment of sewage, the term '*aerobic'* given in bold and a diagram showing the entry of compressed air as stimulus material. Despite this, some candidates wrote at length about the anaerobic digestion of sludge, production of methane and its use. Unless these answers drifted into aerobic digestion, there were no marks that could be gained. Where candidates wrote about the trickling filter method, overlap points with the activated sludge method meant that marks were available. Stronger candidates gave well organised accounts, showing an understanding of why sewage treatment is necessary and having a good grasp of the role of microorganisms in the breakdown of organic compounds and in the elimination of pathogens. Many answers included named microorganisms, *Zoogloea* being a popular choice but not always spelt correctly. More comprehensive accounts explained the benefits of floc formation. Some thought that *Zoogloea* was only present in the settling tank, others noted that sludge was recycled but failed to explain that the importance of this was in the recycling of the microorganisms involved in the digestion process.

Teaching Tip

Candidates should be aware that the number of lines given in which to answer a question serve as guidelines only and cater for those with larger than average handwriting. In extended answers, the number of mark points given for each subsection are a good indicator – a strong candidate who has given eight to ten relevant, varied and sequentially organised points in well-written sentences is highly likely to have satisfied the requirements of a mark scheme with a max 7 allocation and should be advised to move on to the next question. If there are lines left, continuing onto other topics (in this case, anaerobic digestion) is unlikely to be of benefit and may well lose the candidate the QWC mark.

A card sorting exercise, repeated a few times as a starter activity, is ideal to help candidates distinguish between secondary anaerobic and secondary aerobic treatments. A collection of cards each containing terms or mark points from each of the processes (activated sludge and trickling filter methods could have their own additional points) could be prepared. Students could be asked to: sort into the different processes; pick out only those associated with anaerobic treatment etc.; and / or place cards into a logical order.

5 Q.5 required candidates to consider applications and social and ethical issues of two different topics from this option unit: biosensors and genetically modified crop plants. There were synoptic elements throughout this question. Many candidates could use the information and stimulus material given to produce considered, knowledgeable responses. Not all candidates could assimilate the information, however, and wasted valuable time repeating the text or copying out the diagram (in Q.5(a)(iii)) and providing no extra information. The answers given by many could have been enhanced by a greater use of scientific terminology.

Q.5(a)(i) was generally well known and accurately answered but (ii) was not well known. Good responses were able to consider how an inhibitor would affect the role of acetylcholinesterase in synaptic transmission and gave accurate detail. Many were able to gain one mark by suggesting how organophosphates inhibited enzyme action. There were also numerous incorrect responses, ranging from poor digestion of food to acetycholine accumulation proving to be toxic. Marks were awarded in Q.5(a)(iii) for diagrams that showed immobilised acetycholinesterase on the biological recognition layer and hence gave additional information to that provided in Fig. 5.1. Up to four marks could be gained by a good understanding of biosensors. To achieve the full five marks, candidates needed to realise that the substrate acetycholine was added in order to determine the concentration of organophosphate by the level of inhibition shown. There were some excellent responses provided by some candidates, but for others there was a poor grasp of the concepts involved and a minority of responses produced diagrams of a pregnancy testing strip. Q.5(a)(iv) was very well answered by the majority of candidates, with many suggesting four or more valid advantages of organophosphate biosensors.

Q.5(b)(i) was relatively straightforward for those who had registered that glyphosate was a herbicide that could act as an enzyme inhibitor and who could then remember details of inhibition at a molecular level from AS. There were some who had not read the information carefully and had mistakenly thought that glyphosate was an enzyme. The range of correct responses was seen for Q.5(a)(ii) and most candidates could gain at least one of the two marks. The most common misconception was that glyphosate acted as an insecticide, so there were accounts of 'making insect pests resistant'

Candidates did not always find it easy to express themselves adequately when answering Q.5(c) and only a few responses used appropriate scientific terminology to give high quality answers. Surprisingly, many did not use the term 'gene' and failed to mention a vector / plasmid. Hence, there were accounts of 'cutting DNA into fragments', or 'cutting up DNA', with no indication that a desired gene may have been 'cut out' for use. A popular response for the role of DNA ligase was to state that 'sticky ends were joined together' and only a minority of responses correctly indicated that ligase catalysed the formation of the phosphodiester bond, so sealing the sugar-phosphate backbone.

Teaching Tip

Candidates could use Q.5 to identify all the synoptic strands from Central Concepts and the AS specification.
The accepted term, *partially permeable*, should be used to describe the nature of the cell membrane: *semi permeable* should be rejected.

6 **Q.6** was intended to be a fairly straightforward way of testing learning outcome 5.8.4(c). Although the well prepared candidates had no problems gaining 4 or the maximum 5 marks, **Q.6** proved to be quite a challenge for many and a whole host of responses were given that were obvious guesses. Generally, there was a lack of knowledge and understanding of the production of yeast extract and for this half, there were blanks left on numerous occasions.

2805/05 Mammalian Physiology and Behaviour

General Comments

The paper was of appropriate difficulty and comparable to those of previous sessions. Candidates were able to complete all questions in the time available and most attempted every section. There were no obvious misinterpretations of the rubric. Stimulus material was provided for several sections to aid candidates in the formulation of their responses.

Some scripts were very difficult to decipher especially where a candidate's writing was very small: perhaps centres should be encouraged to request the use of a laptop where the quality of writing could result in marks being lost if crucial words are not clear, particularly where the correct spelling is required before the mark can be awarded.

Comments on Individual Questions

Questions

Q1 This question required candidates to apply their knowledge to new situations and included a synoptic section as well as a calculation.

(a) **(i)** Many candidates were able to calculate the percentage of correct identification of urine from patients with bladder cancer by dogs based on chance alone. Answers expressed to either one or two decimal points, correctly rounded up, were acceptable although responses rounded up to a whole number were only awarded one mark. Where an answer was wrong, a mark was awarded if the correct working could be seen.

(ii) The kind of stimulus which activates sensory receptors in the dogs' noses was more often named as 'smell' rather than 'chemical'.

(b) There were many good descriptions of a technique that could be used to train dogs to detect bladder cancer. Most candidates were able to state that correct identification of the diseased urine by the dog would result in a reward, many then offering a suitable example, such as food or praise. Some references to negative reinforcement were also seen. Most candidates appreciated that this was an example of operant conditioning although a large minority mentioned classical conditioning, then suggesting that the identification of the diseased urine should be accompanied by the ringing of a bell. Nevertheless, good candidates understood that associative learning would take place, expressed in a variety of ways.

(c) In this synoptic section, candidates were provided with information as to how dogs are able to taste sweet food while cats cannot, with detail of the protein receptors required for the detection of sugar molecules. It was expected that candidates would express their responses in terms of the processes involved in the synthesis of the non-functional TIR2 protein subunit. Weaker candidates simply restated the facts already given while better ones understood that missing DNA would result in errors in transcription and translation, causing a change in primary, secondary and tertiary structure. References to quaternary structure were ignored as only one subunit was involved. Some recognised that the different species would have a different allele for the TIR2 protein, and occasionally went on to state that a deletion, or mutation, had occurred in the cat, accounting for the altered DNA sequence.

(d) **(i)** Most candidates appreciated why the carnivorous behaviour in mice from Gough Island is not innate, frequently stating that this behaviour is not exhibited by mice of the same species on other islands, and is therefore not stereotypic. Many commented the behaviour is not instinctive, or coded for by the genes, and is therefore learned by the mice. Some also referred to the fact that the behaviour may have arisen due to adaptation to their environment.
(ii) There were a number of different suggestions as to why the mice on Gough Island were three times larger than those on other islands. Many candidates understood that a high protein diet, or a greater abundance of food from eating chicks, would contribute to their larger size, although relatively few mentioned the significance of more amino acids contributing to enhanced growth. Some suggested that larger mice had a selective advantage, both for consuming chicks and evading predators, although these reasons were not credited. Few commented that it would be easier to digest protein rather than fibre.

Q2 This question commenced with an interpretation of graphical data with subsequent sections requiring fairly straightforward recall of knowledge. In general, the question was well answered by most candidates, enabling them to score high marks.

(a) Most candidates appreciated that the populations of both species fluctuated over time, and some gave suitable paired figures to illustrate their answer. However, weaker candidates quoted numbers and years for one or both species, without linking them, and some neglected to notice the different scales for the two mammals. Better candidates commented that the trend in the wolf population followed that of the moose, often giving further clarification by stating that there was a lag period of five years.

(b) Candidates were provided with photographs of the skull of a wolf and a moose as stimulus material to help them describe the features and functions of the teeth of the two mammals. Many comprehensive responses were seen. Most candidates commenced with the wolf, naming the teeth shown followed by an explanation of their use. The canines were the most common starting point, with candidates referring to their sharp, or pointed, shape for the gripping or piercing of prey. References to killing prey were also accepted. Many then continued to describe the premolars and molars, often referring to them as the carnassials, with accounts of their scissor-like or shearing action to slice meat or crush bone. Some candidates also appreciated how the vertical movement of the jaw would aid in the shearing action. The functions of the incisors in grooming or scraping meat off the bone were also mentioned by a number of candidates although their suggested use in the tearing or slicing of meat was not credited.

The dentition of the moose was also frequently well explained. Many responses began by describing the position of the incisors only on the lower jaw, going on to state that they were replaced in the upper jaw by the horny pad, against which they would bite to crop grass. Weaker candidates failed to identify in which jaw the incisors, or the pad, would be found and either neglected to state the function of the horny pad or suggested that it would be used in mastication of plant material. There was frequent mention of the diastema, with candidates often stating that this was as a result of a lack of canine teeth. However, the role of the tongue in the manipulation of food within this area was sometimes omitted. Many candidates appreciated that the premolars and molars were important in the grinding of plant material, although marks were lost where responses lacked detail, for example, by failing to mention the presence of ridges, or the necessity for the sideways movement of the jaw to enable the grinding motion. However, there were many references to the fact that the herbivore molars would be worn down over time and therefore require replacing.

The quality of communication mark for this free response question was for spelling, punctuation and grammar. Most candidates were awarded the mark.

(c) **(i)** The vast majority of candidates were able to identify the process shown as hydrolysis.

(ii) Most candidates named pepsin as the enzyme which would catalyse the conversion of protein to peptides at pH 2, although some incorrect references to trypsin, or an unspecified protease, were seen.

(iii) The enzyme catalysing the conversion of peptides to amino acids was occasionally incorrectly named as endopeptidase although many candidates stated exopeptidase or another acceptable alternative, such as carboxypeptidase.

(iv) Most candidates appreciated that final protein digestion would take place in the duodenum, ileum or small intestine.

Q3 Many candidates performed well in this question, scoring highly particularly in sections (a) to (c).

(a) The limb bone arrangement illustrated in Figures 3.1. and 3.2 was identified as pentadactyl by the majority of candidates. Mis-spellings were accepted if phonetically correct.

(b) Many candidates were able to name the bones A to D although some neglected to note that it was a forelimb and named equivalent bones for the hind limb. A variety of spellings were again seen for phalange (A) although the benefit of the doubt was often given if sufficiently close. B proved to be the most difficult bone to identify, many believing it to be a carpal or tarsal, rather than the humerus. Most candidates recognised that C was a carpal bone, although references to metacarpals were also allowed, and that D was the radius.

(c) The joint between the upper limb bone and the shoulder blade was named as a ball and socket, or synovial, joint by most candidates who often continued to give a comprehensive description of its range of movement.

(d) There was occasionally confusion between rheumatoid arthritis and osteoarthritis, where candidates suggested that the latter condition was a hereditary, autoimmune disease. Some also muddled osteoarthritis with osteoporosis. Nevertheless, many stated that excessive exercise in early life would precipitate the condition or named a suitable activity, such as dancing or football, as a consequence of joint overuse. Some also named a particular joint, such as the knee, as being particularly vulnerable. Many understood that obesity would a causative factor. There were fewer references to the earlier degeneration of the cartilage although some candidates appreciated that cartilage would be broken down faster than it could be replaced.

(e) **(i)** This synoptic section was preceded by a diagram of the synapses in a pain pathway to aid candidates to suggest how endorphins may act to reduce pain. Many understood that the release of endorphins from the spinal neurone would result in their binding to the opiate receptors on the presynaptic knob, thereby inhibiting neurotransmitter release. References to vesicles binding to the opiate receptors were rejected. Good responses included detailed descriptions of the how inhibition would arise, stating that preventing the diffusion of calcium ions into the knob would then block acetylcholine release, so there would be no neurotransmitter to bind to ACh receptors on the postsynaptic neurone and therefore no impulses

sent to the pain centre in the brain. Some candidates mistakenly believed that endorphins would compete with ACh for the receptors on the postsynaptic membrane or that they would bind to ACh itself to prevent binding.

(ii) Many candidates were able to offer a suitable advantage of using TENS for pain relief over more conventional treatment, such as it would obviate the need for painkillers or injections. Others suggested that it would be a cheaper alternative or that there would be no side effects.

Q4 The second free response section of the paper was included in the section although it was frequently omitted by weak candidates.

(a) Most candidates were able to label the rough endoplasmic reticulum, and the precise areas where neurotransmitter vesicles, and rhodopsin, would be located on the diagram of the rod cell.

(b) Although many candidates drew an arrow to represent the direction of light correctly, some orientated it in the opposite direction, pointing downwards instead of upwards.

(c) Weaker candidates who actually attempted this section performed poorly, often failing to score more than one or two marks due to vague answers lacking any creditable detail, or a description of how stimulation of a rod cell would result in impulses passing to the brain, which was not required by the question. However, those who had learned the material well managed to achieve maximum marks with ease. Most candidates commenced with general comments about rhodopsin followed by a description of the events taking place following stimulation by a photon of light. Surprisingly few candidates mentioned that light would be absorbed by the pigment, simply stating that light would hit it. Nevertheless, many understood that this would cause the retinal to change shape from 11-cis to the all-trans form. The dissociation of retinal from opsin was occasionally mentioned. Most went on the state that the sodium and potassium ion channels would close while the sodium potassium pump would continue to work, resulting in the hyperpolarisation of the rod cell by changing the electrical potential from $^{-}40$ to $^{-}70$ millivolts. Many also appreciated that this change would stop the release of neurotransmitter from the presynaptic membrane although few mentioned that the transmitter was inhibitory. References to the location of either retinal or opsin were rare.
The quality of written communication mark was for a clear, well organised account using specialist terms. Mention of at least three suitable terms was required and good responses were awarded the mark.

(d) In this section, candidates were required to name the colour perceived by the brain upon the stimulation of one or more of the three photosensitive pigments in cone cells by referring to the absorption spectra provided in Figure 4.2. The majority of candidates were able to give the correct colour for two or three examples, thereby achieving at least one mark. Good candidates identified all six colours perceived correctly for the full three marks.

Q5 This question proved to be the best discriminator of the paper. Many candidates found it difficult, particularly section (a), although they managed to score some marks on subsequent sections.

(a) Candidates were furnished with a diagram of the movement of fluid between the capillary and tissue fluid and then asked to explain how this movement would be achieved at both the arterial and venous ends. Regrettably, many concentrated on describing the facts already given, without providing any further detail as to why the processes would take place. Nevertheless, many managed to score at least one mark for recognising that albumin in the blood would contribute to its low solute potential and occasionally continued to add that albumin was too large to leave the capillary, thereby gaining a second mark. Relatively few candidates mentioned that the fluid would leave the capillary via gaps between the endothelial cells. Many also failed to appreciate that the two important forces in the movement of fluid out of or back into the capillary were the hydrostatic pressure and solute potential gradients, giving vague answers concerning concentration gradients or simply omitting the term gradient completely. Good candidates recognised that the hydrostatic pressure exceeded the solute, or water, potential gradient at the arterial end, resulting in the net movement of fluid out of the capillary, whereas the opposite would take place at the venous end. Many also made a comparative comment concerning the water, or solute, potentials in the capillary and tissue fluid. References to the high hydrostatic pressure at the arterial end being due to ventricular contraction or the contribution of capillary resistance to the low hydrostatic pressure at the venous end were rarely seen.

(b) Good candidates were able to offer reasonable suggestions as to why a low protein diet would result in a bloated abdomen and fluid retention in tissues. Many understood that albumin synthesis by the liver would be compromised or, alternatively, that the albumin concentration in the blood would fall. This was often then linked to reduced fluid reabsorption into the capillary. However, some candidates failed to gain a mark for stating that there would simply be less albumin, or reduced synthesis, without further qualification. Some candidates gained a mark for the mention of oedema.

(c) There were many detailed accounts of lipid metabolism in liver cells during dieting or exercising, although occasionally metabolism in adipose cells or muscle cells was described. Most candidates commented that lipids would be hydrolysed to fatty acids and glycerol, often carrying on to state that fatty acids would be converted to acetyl coenzyme A which would enter Krebs' cycle. Many referred to glycerol either entering glycolysis or being converted to glucose via gluconeogenesis, although some believed that fatty acids could enter these pathways. Better candidates also mentioned the synthesis of ketone bodies. Weaker candidates frequently only gained a single mark for understanding that fats would be respired.

(d) References to a lack of leptin triggering hunger or initiating eating behaviour were surprisingly few. Many candidates erroneously believed that low leptin concentration would result in lethargy. Some suggested physiological responses which were not required by the question.

(e) **(i)** The majority of candidates were able to gain full marks for the calculation of the body mass index from the figures provided. However, some made the mistake of expressing their answer to two decimal places, rather than rounding up to the nearest whole number.

(ii) Most candidates gained a mark for suggesting that obesity in T would be precipitated by either a poor diet high in saturated fats, or lack of exercise. Better

candidates attempted to describe the inheritance of two recessive alleles, one from each parent, which would prevent the synthesis of leptin. However, some believed that leptin would cause obesity rather than prevent it or failed to appreciate that leptin was coded for by the dominant allele, although this was stated in the stem of the question. Vague references to dominant or recessive genes were rejected.

Q6 Most candidates were able to gain reasonable marks for this question, particularly for the synoptic section on cancer.

(a) Despite the fact that the question required candidates to both describe and explain the changes in adrenaline concentration taking place before and after a gallop, weaker candidates concentrated solely on interpreting the graph. Many noted that the concentration would increase before the gallop although the mark was not awarded without further qualification, such as a steep, or rapid, rise. Most gained a mark for recognising that adrenaline would then decrease afterwards. Paired figures were often quoted although the units were occasionally incorrect or omitted. Better candidates went on to explain the effect of increased adrenaline concentration, frequently describing its role in elevating heart rate and promoting glycogenolysis or conversely, stating that these effects would be reduced after the gallop. Few references to the widening of bronchioles, or the stimulation of adrenaline secretion by the sympathetic nervous system were seen. Only rarely were full marks awarded for this section.

(b) Many candidates gained credit for understanding that immediately after the race, the heart rate would remain high to pay off the oxygen debt or reduce the high carbon dioxide concentration in the blood. Responses often then continued to describe the role of the parasympathetic nervous system in lowering heart rate and force on contraction by sending impulses via the vagus nerve to the sino-atrial node in the wall of the right atrium, although references to the medulla oblongata were relatively infrequent. Good candidates also appreciated that there would be a fall in blood pressure.

(c) **(i)** While some candidates offered factors that could increase the chances of a developing cancer in humans, such as smoking, these answers were rejected as they were inappropriate to racehorses. Nevertheless, many gained both marks for stating that the condition might be hereditary, expressed in a number of ways, or that the horses may have been exposed to a source of ionising radiation or a carcinogen.

(ii) Most candidates commented that the precipitating factors named in (i) would lead to uncontrolled mitotic division resulting in a tumour although few made reference to unspecialised cells or the activation of oncogenes. However, many gained full marks for this section.

(iii) Many candidates were able to state at least one physiological function that could be affected by cancer of the medulla oblongata, most frequently breathing rate. Good candidates also mentioned blood pressure or peristalsis. References to the contraction in the smooth muscle in the gut were not credited.

(iv) A suitable treatment for cancer of the medulla (radiotherapy or chemotherapy) was offered by the vast majority of candidates. Surgery was rejected. A surprisingly large number of candidates were unable to spell chemotherapy.

2806/01 Unifying Concepts in Biology - Written Paper

General Comments

Candidates performed well on this paper. The reduction of questions from five to four meant less reading and assimilation of context material, meaning candidates finished the paper comfortably in the time allowed. Candidates reported finding the paper challenging to do, but they were able to display their biological knowledge and skills in a range of contexts and the majority notched up creditable scores. Most showed sound understanding of basic biological concepts. The mark scheme discriminated well between candidates of differing abilities, with better candidates scoring marks for added detail.

Comments on Individual Questions

Q1 Although the context of competition between red and grey squirrels is well-known, this proved the lowest-scoring question on the paper. It probed a knowledge of classification, ecological concepts, digestive enzymes and cell biology.

(a) Candidates could obtain full marks for explaining why both types of squirrel had the word "*Sciurus*" in their Latin name either by reference to knowledge of classification, or to knowledge of evolution. Candidates who did not understand or remember the Linnaean system of classification most often confused "genus" with "family".

(b) This question combined graph data analysis with evaluation skills. Surprisingly few candidates gained all three marks. There were few correct data quotes for example (two comparative figures with a clear x axis time reference for each were required). Candidates should refer to the context of the data ("In deciduous woodland grey squirrels living alone …") not just "In A …". Candidates should avoid repeating the question in their answer. The evidence for competition when the red and grey squirrels lived together is that the number of reds declines, not that "the greys out-compete the reds".

(c) Candidates scored for suggesting more food was available, that the food supply was more varied and that this variety could mean food supply was more continuous. The use of the word "nutrients" for the squirrels' food source was not credited. A surprising number of candidates referred to the squirrels as eating "prey", despite the fact that grey squirrels are stated as eating acorns in part (d). Candidates trying to describe the way the squirrels made use of microhabitat features such as nesting and hibernation sites often used the words habitat and niche incorrectly. The habitat in this case is the deciduous woodland. The niche is the organism's role in the ecosystem.

(d) This question proved a tough discriminator. The correct reasoning is that digestive enzymes precipitate (and therefore denature) in the presence of tannin and macromolecules are therefore not digested and absorbed. The common error was to think that dietary protein precipitated and that this prevented its being digested. Another error that cropped up was the misuse of the word "excretion" for "egestion".

(e)(i) The correct answer of Golgi was frequently given but wrong answers included nucleus, cytoplasm and ribosomes.

(e) Most candidates gave the quantitative difference, sometimes twice in the form of
(ii) "greys have more PRPs, reds have less PRPs". Candidates should be made aware that reverse reasoning like this will not score again. Fewer correctly expressed the qualitative difference, that greys have PRPs specific to acorn tannin.

Teaching tip

Candidates should beware of giving the same answer twice by giving the reverse argument the second time.

Data quotes from a graph need an x axis reference.

Q2 Candidates were tested on knowledge of the respiratory system, asthma, neurotransmitters, enzymes and enzyme inhibitors. Candidates scored well, particularly on part (e), but some failed to answer the question that was posed in the longer answer component (f).

(a) Acceptable answers for airways that constrict during an asthma attack were bronchi and bronchioles. Although the trachea has smooth muscle the extensive areas of cartilage prevent appreciable constriction. A minority of candidates confused the respiratory and digestive systems and answered oesophagus.

(b) Candidates did well on the comparison of inhaled versus oral medication, frequently stating that inhalation will deliver the drug directly to the airways and that delivery will therefore be faster. A disappointing number thought the tablet salbutamol would have to be digested, instead of realising that a problem of oral medication is that a drug could potentially be altered and made ineffective by the digestion process. Few candidates considered the issue of effect on smooth muscle elsewhere in the body and possible side effects.

(c) Most candidates realised salbutamol binds to noradrenaline receptors, gaining two marks. Fewer realised that the site of action is the smooth muscle at the neuromuscular junction, so there were erroneous accounts concerning synapses. An error was to transfer the idea of shape recognition of ligand and receptor to the enzyme-substrate context and to state that salbutamol fitted into the active site of an enzyme.

(d) This was well done with many candidates scoring two marks for explaining that the salbutamol cancels out the effect of the β-blocker and that the heart rate can therefore speed up again.

(e) Most candidates found this straightforward and gave more than three reasons why phospholipase A2 should be a protein. All the mark points were accessed frequently.

(f) The major criticism of the essay question is that too many candidates quoted text book accounts of the mode of action of competitive and non-competitive inhibitors, rather than describing how they would carry out a laboratory experiment. Of those who did attempt to describe a laboratory test, common marks lost were those concerned with basic experimental protocol such as standardising control variables such as volumes (not amounts) and temperature. Quoting a detail such as how the variable is controlled or measured (e.g. syringe, water bath) earned a further mark, as did the statement that repeats would be carried out. A good account contrasted a control experiment without an inhibitor with a second test containing the inhibitor, to show how the rate slows down. To distinguish a competitive effect the candidates should then have varied substrate concentration to see if an excess of substrate was able to out-compete the inhibitor and restore the uninhibited maximum rate. Many candidates chose to vary the inhibitor instead, which is a valid approach but few were able to correctly describe the results that would indicate a competitive inhibitor. There were many errors concerning the labelling of the axes of graphs, with candidates confusing rate with amount of product, and putting time on the x axis rather than substrate concentration. Very few candidates are aware of the significance of measuring the initial rate of reaction and comparing this at different values of the independent variable. Lastly, a good number of candidates confused the enzyme and its substrate and spoke about the inhibitor competing with the enzyme for the substrates.

Teaching tip

Candidates should expect to be asked to describe experimental set-ups in this paper and need to be taught the principles that hold good in any experiment, such as controlling extraneous variables and conducting repeats.

Q3 Candidates scored marks well on most sections of this question about the biology of the Venus Fly Trap, but part (c) on the nitrogen cycle proved beyond many.

(a) (i) Most candidates picked up at least two marks here, for stating that chlorophyll for photosynthesis is the reason for the green colour. The detail that chlorophyll reflects green light or maximally absorbs red and blue wavelengths was often added. Few added any further detail of the significance of this pigment and photosynthesis for the plant (manufacture of sugars.) It was clear that some candidates did not appreciate that carnivorous plants are still largely autotrophic.

(a) (ii) The red colour and an attractive smell were the commonest reasonable suggestions.

(b) (i) Candidates successfully applied their knowledge of establishment of resting potential and action potentials in nerve cells to this unfamiliar context. The commonest reason for marks to be lost was to refer to sodium and potassium moving across the membrane but to fail to state that the molecules that move are charged ions.

(b) (ii) Candidates interpreted the flow diagram correctly and in the main stated calcium pectate. Cell wall was not a sufficiently detailed answer.

(b) (iii) Candidates showed good understanding of the principles of osmosis and most used water potential terminology correctly. An error that cropped up however was to say that the influx of calcium ions raised the solute potential and therefore lowered the water potential. Both solute and water potential decrease as solute concentration rises.

(c) (i) The activities of the nitrogen cycle bacteria seemed a less well-understood area and many candidates incorrectly reasoned that a thriving population of denitrifiers and reduced activity of decomposers would result in a higher rather than a lower nitrate concentration in the soil.

(c) (ii) Only the most astute picked up the reference on the previous page to the Venus fly trap's protease enzyme, or linked nitrates to nitrogen-containing compounds such as amino acids, protein and nucleic acids. There were many poor answers stating that digestion of insects releases nitrate which the plant then absorbs.

Teaching tip

Candidates should be encouraged to read every word of the question stem carefully as information given may lead to the correct answer.

Q4 This was the question where candidates were most likely to score full marks.

(a) Most candidates picked out two descriptive points from the text and diagram but not all could follow through with a reasoned explanation of how the feature was an adaptation to photosynthesis. The fucoxanthin absorbs different wavelengths of light, not merely "more light".

(b) The calculation proved problematic for many. Candidates needed the basic knowledge of the number of daughter cells produced by mitosis (2) and meiosis (4) to be successful in this calculation.

(c) (i) & (ii) Most correctly interpreted the life cycle diagram in the light of information given in part (b) (that meiosis happens in the conceptacles) and wrote mitosis for (ii) and correctly identified the gametes as haploid and the rest of the life cycle stages as diploid.

(d) Good answers were written with accurate references to the use of quadrats, different types of transect and ways of estimating percentage cover. Those with some practical experience were able to give fuller answers and include details such as the fact that the survey needs to be carried out at low tide.

Teaching tip

Ecology should be taught in a practical context where possible.

2806/03 Practical Examination

General Comments

Candidates were not always well prepared for the examination, especially in centres that had small entries. It was felt that candidates had not been advised to revise topics from the AS specification and from Central Concepts (2804) prior to the examination and could not cope with questions relating to these specifications.

Q.1 was an investigation into the effect of different wavelengths of light on the rate of photosynthesis of a leaf extract. This did not cause any problems, although some centres appear to have had minor difficulties in producing a sufficiently strong DCPIP solution to give a good colour with the leaf extract. However, most candidates managed to obtain the correct trend in their results.

Q.2 tested the interpretation of electron micrographs of chloroplasts and the functions of the component parts of the chloroplast.

Comments on Individual Questions

Planning Exercise

This was a relatively simple exercise in which candidates had to plan an investigation to compare the effect of changing one limiting factor on the rate of photosynthesis, in sun and shade leaves.

Candidates were given a method to follow. This involved cutting leaf discs that were then placed in a syringe. The syringe was then filled with water, or dilute sodium hydrogen carbonate solution. Air was removed from the syringe and from the intercellular spaces of the leaf discs until the leaf discs sank. As the discs photosynthesise they produced oxygen that accumulates in the intercellular spaces, lowering the density of the leaf disc. The time taken for the discs to rise provided a measurement that could be used to calculate the rate of photosynthesis.

Most candidates gave good general plans but failed to supply the necessary detail. A few candidates were penalised for ignoring the instructions given. They planned an investigation that involved counting bubbles of oxygen released from the discs, or measuring volumes of gas produced.

Differences between sun and shade leaves were generally well researched, although some candidates selected leaves for their investigation that do not show typical sun and shade differences. Radish and geranium were noticeable examples. Many candidates gave a lot of irrelevant information on photosynthesis and failed to recognise the significance of the processes resulting in the production of oxygen. Others discussed all the limiting factors without putting any emphasis on the one they had chosen to investigate.

Some good preliminary work was done by candidates who tested one or more of the factors to find a suitable range of values for their independent variable. These gave the results from their preliminary work and used them to inform their plans. Others were able to establish these values from their background research, but not all explained how they would use this information, and some even failed to use their researched values in their plans.

There was also evidence that many candidates were quoting information as their preliminary work when it was evident that had not actually carried out any preliminary experiments.

Candidates should be encouraged to tabulate their preliminary results as evidence of work done.

Candidates did not indicate where they had used information from secondary sources. This could be given as a reference in the text or as a footnote at the end of the page linked by a superscript number. Many candidates gave bibliographies at the end of their plans but did not show in their text where they had used these secondary sources. Some candidates are inserting references at random. These do not always bear any relationship to the aim of the investigation, and some of the references did not offer the information claimed by the candidate.

Candidates were expected to select a range of five values for their continuous variable that would not inhibit photosynthesis completely, e.g. temperatures in the range of 0°C to 50°C. It was evident that weaker candidates were relying on their knowledge of mammalian enzymes and did not realise that the optima for plant enzymes is considerably lower.

Many candidates suggested the use of a light meter for measurement of light intensity but did not seem to be aware of the actual light intensities represented by their quoted values. Other candidates had researched tables of light intensity and selected a range that corresponded to a variety of conditions from a dull day through to strong sunlight.

Candidates are competent at listing variables that need to be controlled but then fail to include a thermometer for measuring room temperature, or the necessity for a darkened room with a single light source, in their apparatus.

Many candidates failed to recognise the need for precision in their plan. Some had done sufficient preliminary work to realise that it was likely that the discs would not all rise at the same time. These candidates used several discs for each test and measured the time for a specific number to rise. Others only used one disc and gave no indication of a time limit if the disc failed to photosynthesise.

Many candidates seemed to think that sodium hydrogen carbonate was a highly dangerous chemical. Considering they were told that they would be supplied with a 'very dilute solution', this was not considered acceptable for the risk assessment mark. Candidates are still not stating the true nature of the hazard and the precautions to be taken to prevent injury. Examples such as 'Take care with water and electricity', or 'Cork borers are sharp', were not credited.

Blank tables for results should be fully headed, with the independent and dependent variables, and the correct units should be given. Units should not be given in the main body of the table. Similarly graph axes should be correctly labelled with units. In this exercise the examiners were looking for the rate of photosynthesis to be plotted against their chosen variable.

Most candidates gave the formula of 1/t for calculating the rate of reaction but few suggested any statistical test to compare rates between sun and shade leaves. There was some attempt to comment on the validity of their expected results but many candidates only repeated the variables that they intended to control.

Unfortunately there was evidence that the amount and type of tutor guidance influenced the design of the plans on a centre wide basis.

On the whole, the quality of the written communication, particularly the standard of grammar and punctuation, was better than in previous years. There were fewer very long plans, possibly due to the more concise nature of the investigation.

Some handwritten plans were almost illegible, and the lack of margins on both sides of the page made them more difficult to mark. The use of very small typefaces also made some plans difficult to read.

Schools are requested to punch holes and join pages of plan with tags, rather than stapling the pages, and also to join the plans to the back of the practical tests.

Practical Test

Q1 Most candidates realised that the principle examined here was the effect of different wavelengths of light on the light dependent reaction of photosynthesis but not all interpreted their results correctly. Sometimes the lack of reaction under the green filter was interpreted as an anomaly.

(a) Candidates frequently failed to construct their table of results following the usual criteria. The examiners were looking for the independent variable – wavelength of light - to be given in the first column of the table, followed by time and rate. The correct unit for rate was often omitted. Many candidates headed the first column as 'colour'. This error was often carried forward to the graph where they plotted colour against rate or time. Sometimes the colours were incorrectly listed in the order of their reaction time, as these candidates were looking for a smooth curve for their graph.

Some candidates failed to follow the instructions to record time in seconds, although some did make the conversion from minutes to seconds to calculate the rate. Examiners expected time to be recorded to the nearest whole second. The level of accuracy involved in timing a colour change did not warrant timing to tenths and hundredths of a second.

Most candidates were able to calculate rates correctly. Examiners were looking for calculations corrected to one or two decimal places. It was considered that just whole numbers did not give sufficient precision for plotting the graph and equally candidates could not plot two or three decimal places on their graphs.

(b) Most candidates were able to orientate their graphs correctly and made sensible use of the space available. Some took this to the extreme by choosing scales that made it difficult for them to plot their points accurately. Many failed to join plots with straight lines between points or sensible lines of best fit. Some candidates seemed to think that lines of best fit should miss all the plotted points.

(c) Most candidates commented accurately on the pattern of their results. Candidates who realised their graph was action spectrum had no difficulty in explaining their results in terms of the wavelengths of light absorbed, but few recognised the relationship with the absorption spectrum for chlorophyll. Fewer candidates gave correct information on the release of hydrogen ions and / or electrons leading to the reduction of DCPIP.

(d) This question was similar to the one set on a previous paper. A large number of candidates do not understand the significance of using a control experiment. Many suggested using leaf extract and DCPIP kept in either the dark or under white light.

(e) Generally candidates were able to identify limitations in their apparatus and procedures. Many correctly noted that factors such as light intensity and temperature were not controlled. The use of a thermostatically-controlled water bath was hardly suitable in this investigation where the tubes were open at both ends. Similarly the use of a colorimeter was not considered to be appropriate. Many candidates though they could eliminate the effect of ambient light by setting up the experiment in a dark room. There were many good suggestions for eliminating the effect of white light entering through the open ends of the filters. Many candidates commented on the different volumes of DCPIP that different students might have used to achieve the blue-green colour, but failed to realise that their solution might have changed colour due to photosynthesis occurring before each tube was set up.

(f) Candidates often confused NADP and NAD and gave descriptions of Kreb's cycle. Many correctly described the photolysis of water to produce the hydrogen ions that reduced the NADP and some went on to explain the used of $NADPH_2$ in converting GP to TP in the Calvin cycle.

Q2 This linked question 1 and the planning exercise.

(a) Most candidates measure the distance on the chloroplast correctly in cm or mm but many did not know how to convert the measurement to a magnification. A large number of candidates used a formula for the calculation, and having obtained the correct figures they could not convert it to micrometres and therefore ended up with the decimal point in the wrong place.

(b) Many candidates gave features that were not visible in the photographs – including chlorophyll, protein molecules, DNA and ATP. Many candidates confused thylakoids and grana thinking they were the same structure. Small black spots representing lipids, were often misnamed starch grains. Other candidates thought they were looking at a cell and described cytoplasm, nuclei and even stomata! Some candidates misinterpreted the question and described the appearance of the actual structure, rather than its appearance in the photograph. These candidates were given credit for accurate descriptions.

(c) Examiners saw many excellent accounts of the chemical reactions that occur during photosynthesis, but these gained few marks, as candidates did not refer to parts of the chloroplast that were visible in the photographs. Many errors were carried forward from (b) with details given about cell walls and cytoplasm. Candidates who recognised the large surface area provided by the thylakoid membranes were then able to explain the increased light absorption and subsequent events, gaining maximum marks for the question.

(d) The comparison of the photographs produced some marks for most candidates, but others were penalised reference to different colours, amounts of chlorophyll present and for incorrect biology;

(e) This question was poorly done. Many candidates used it as an opportunity to write all they knew about photosynthesis, while others repeated information given in previous answers. Many thought ribosomes were vesicles transporting substances around the chloroplast. The need for more protein production when the leaf is exposed to light was not appreciated. There was confusion and uncertainty about the role of ribosomes in producing proteins that would then be used to produce other substances such as enzymes, chlorophyll and other pigments.

Grade Thresholds

Advanced GCE (Subject) (Aggregation Code(s))
January 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
2801	Raw	60	39	34	29	24	20	0
	UMS	90	72	63	54	45	36	0
2802	Raw	60	42	37	33	29	25	0
	UMS	90	72	63	54	45	36	0
2803A	Raw	120	93	83	73	63	53	0
	UMS	120	96	84	72	60	48	0
2803B	Raw	120	93	83	73	63	53	0
	UMS	120	96	84	72	60	48	0
2803C	Raw	120	90	81	72	64	56	0
	UMS	120	96	84	72	60	48	0
2804	Raw	90	65	58	51	44	38	0
	UMS	90	72	63	54	45	36	0
2805 A	Raw	90	68	61	54	47	41	0
	UMS	90	72	63	54	45	36	0
2805 B	Raw	90	60	53	46	39	33	0
	UMS	90	72	63	54	45	36	0
2805 C	Raw	90	63	57	51	46	41	0
	UMS	90	72	63	54	45	36	0
2805 D	Raw	90	67	59	51	44	37	0
	UMS	90	72	63	54	45	36	0
2805 E	Raw	90	64	57	50	43	37	0
	UMS	90	72	63	54	45	36	0
2806 A	Raw	120	88	79	70	62	54	0
	UMS	120	96	84	72	60	48	0
2806 B	Raw	120	88	79	70	62	54	0
	UMS	120	96	84	72	60	48	0
2806 C	Raw	120	83	75	67	60	53	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	7.3	24.3	50.5	75.1	95.1	0	929
7881	11.8	37.3	68.3	87.8	96.7	0	304

1233 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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