BIOLOGY

Paper 0610/01
Multiple Choice

General comments

This year, candidates found only three **Questions** (**15**, **16** and **34**) very difficult. However, 90% or more candidates selected the correct answers to a further 8 questions.

Comments on individual questions

Question 2

The form and appearance of this question might well have discouraged candidates, but with a facility of 95%, they performed very well. Unusually, for a question with such a high facility, it was, specifically, only the very weakest candidates who failed to answer correctly.

Question 3

Again, a very easy question, with only the very weak candidates not selecting the correct answer. Candidates were, perhaps, helped here in that the correct response could have been selected without reference to stomata mentioned in the question.

Question 6

This question posed few problems, possibly because, even for any candidates not familiar with the appearance of a muscle cell, cells A, B and C were all easily recognisable and their functions generally well known.

Question 11

This question proved to be too easy to be of any real value, but it did serve to confirm that the function of an enzyme is universally well known.

Question 15

This proved to be by far the most difficult question on the paper, with the key being the least popular answer. It had been hoped that candidates would appreciate that the cell with the greatest number of chloroplasts would, on a warm, sunny day, be using up carbon dioxide at a rapid rate. However, over a third of candidates believed, perhaps understandably, that carbon dioxide would have no use in the dead elements of the xylem and thus would be present in the lowest concentration.

Question 16

Perhaps still influenced by the difficulty of the previous question, candidates did not do well on this question either. This time, however, it was basic knowledge that let them down. Over a third of candidates believed that glucose, not sucrose, is translocated in the phloem, and a further third were of the opinion that, even in bright sunlight, carbohydrates would move from tubers to leaves.

Question 22

Reabsorption of what and into where often poses problems for candidates at this level. That 95% reasoned their ways to a correct answer is commendable.

Question 27

There was a hint here of some of the better candidates believing that fertilisation is likely to occur around day 22 of the menstrual cycle, when a little more careful thought should have told them that the ovum would, by then, be too far down the reproductive tract. This may be because they thought that this is where fertilisation occurs.

Question 28

This question proved difficult only because a quarter of the generally weaker candidates displayed the standard misunderstanding that light is necessary for germination.

Question 30

A very straightforward question, which candidates found very easy.

Question 34

Pyramids of biomass and of numbers can often lead to confusion, and this question was no exception. Candidates appeared to look for pitfalls that did not exist (though aphids may have been unfamiliar organisms to some). It was reassuring that the most popular answer, by some way, was the correct one, but many of the better candidates were tempted by C (the correct pyramid of *numbers* for the food chain, and not *biomass.)*. Some, perhaps understandably, felt that the biomass of birds in the tree might exceed that of the beetles on which they were feeding.

BIOLOGY

Paper 0610/02

Core Theory

General comments

Although there were a significant number of candidates who failed to attempt all parts of all questions this did not appear to be linked to insufficient time to complete the paper but rather to candidates who seemed inadequately prepared for the demands of the paper. There were candidates who showed very limited knowledge and understanding of some topics from the syllabus and there was virtually no evidence that there were candidates who did not find the paper demanding in at least some of its aspects. Responses to various sections of questions revealed, once again, certain misconceptions and misunderstandings.

There was very clear evidence in a number of places that candidates had not read the questions carefully or thoroughly enough and thus their responses were inadequate or were not on the point that the question was about. Candidates should be made aware of the need to read the questions carefully and to take note of each question's demands.

Candidates should also be made aware of the difference between terms such as 'describe' and 'explain'. Examiners reported an increase in the frequency of difficulty in reading candidates' responses. Candidates should be made aware that although every effort is made to identify what has been written this is impossible at times because of the nature of the writing and consequently there is a potential loss of credit.

Comments on specific questions

Question 1

It was interesting to note the large number of candidates who altered their response in the second word gap to excretion when they selected respiration for the third word gap. A large percentage of candidates gained full credit. Another noticeable feature of the responses was the significant number of candidates who selected the correct four words but attributed them to the wrong gaps and in some cases this resulted in a mark of zero. It was extremely rare for any gaps not to be completed and also for candidates to offer two words in a single gap or to enter words not in the list.

Question 2

A large proportion of the candidates offered two age ranges or two individual ages rather than the single 2 year period requested, suggesting that they had not read the question carefully. Many of the age ranges offered were in excess of 2 years in length, often a 5 year period was quoted. Very often the candidates did not plot the height of males at 2 years, assuming that it corresponded to the plotting of the female plot at 2.5 years. Quite inexplicably there were many candidates who made the heights of females and males coincide at ages 10 and 15 when at both these ages males were clearly 4 cm shorter than females.

Most responses in **(b)(i)** correctly identified females as entering puberty first but than failed to read the stem of **(ii)** that referred to males and quoted female features. Candidates should be made aware that naming a feature does not necessarily identify a change, thus having "hair" or "muscles" is inadequate as a response unless it is linked to the idea of the growth or development of the feature in a specific part of the body. The naming of the hormone responsible for the changes at puberty revealed confusion as it was often not related to the sex of the changes listed in **(ii)**.

Question 3

Despite having the nutritional role of the placenta identified in the stem of the question many candidates quoted this again in their responses. A significant number of candidates referred to the transfer of oxygen and carbon dioxide but failed to identify the direction of the transfer. Other waste substances, such as urea, or the fact that it acted as a barrier to the transfer of pathogens or toxins, were rarely referred to. Even fewer noted production of progesterone by the placenta. Some candidates linked the villi of the placenta to those in the intestine but failed to relate their role to increased surface area and thus improved diffusion.

Many responses in **(b)** placed the **X** in the umbilical cord or within the amniotic fluid rather than at the villi. Responses in **(c)** were often rather vague and there were few who realised that the maternal and fetal blood might be of a different blood group or at significantly different pressures.

Question 4

Although many candidates commented on the fall and subsequent rise in oxygen level in the river, some did not state that the fall happened just after the entry of the untreated sewage. Many candidates ignored the request for a description and tried to explain the changes as well in **(a)**. Very few candidates had any appreciation of how the untreated sewage brought about the effects shown in the graph. The vast majority seemed to have no understanding that untreated sewage contains many bacteria and that these feed on the organic material in the sewage, rapidly reproduce and so cause low levels of oxygen in the river. There were many attempts to explain the changes as if the untreated sewage was a discharge of fertilisers or even to ignore the reference to sewage and to discuss agricultural fertilisers directly. There was obvious confusion between bacteria and algae. Very few candidates tried to explain the rise in oxygen levels further down stream.

Question 5

The majority of candidates completed the food web successfully although there were a few who gave inadequate responses such as insects without specifying whether them were identifying the herbivorous or carnivorous ones, and this applied to the completion of table 5.1 as well. A few answers introduced organisms that were not present in the food web. The commonest error in the table was an attempt to fit grass in somewhere when all the organisms listed in the responses should have been animals. Although the same animal could appear in the two columns a few candidates tried to complete a column by writing the name of the same animal twice, and this gained no credit. In responses to ***Section (b)*** a significant number of candidates revealed their lack of understanding of the arrows in the food web and suggested, for example, that rabbits and voles ate stoats and this made nonsense of their predictions and explanations. Those candidates who identified the correct links and suggested the effects often gained little credit as they simply stated, for example, that “stoats benefit from more food” rather than “stoat numbers increase because of more food”. There were candidates who did not utilise the decrease in the kestrel population as the basis for their predictions but instead considered the effects of pesticides on all the other organisms in the web and some introduced the radioactivity referred to in ***Section (c)*** as a basis for their predictions. Although most appreciated that the radioactive strontium would accumulate in bones or teeth, **(c)(ii)**, some of these candidates had already stated that it would accumulate in the grass, **(c)(i)**, that lacks these tissues.

Question 6

Section (a) instructed candidates to name relevant parts of a leaf and many candidates translated this as a request to name parts of a cell. Also a significant number who identified the two labelled parts as the cuticle and upper epidermis gave their response in the answer spaces in the wrong order suggesting they did not look carefully enough at the positioning of the two labels. In **(b)** transpiration, osmosis and respiration were common erroneous answers. Candidates were far better at labelling a stoma, **(b)(ii)**, than naming and labelling the xylem, **(c)**. In the latter response the tissue was more often correctly named as xylem than in pointing to a xylem component, most commonly in these cases, the label line terminated in the phloem. Another common error was labelling an air space as a stoma. Many candidates ticked the relevant box in each row but gave inadequate reasons for their responses. Simply stating that photosynthesis was not adequate and should have been “used up in” or “produced by / waste product of” should have also been stated. In ***Section (b)(iv)*** very many responses stated that during rainfall water vapour entered the leaf via the stomata.

Question 7

A significant number of candidates left ***Section (a)*** blank and among those who responded there was considerable confusion between alcohol and lactic acid. Few linked alcohol production to anaerobic respiration by yeast or the fermentation of sugars. In a number of cases it was linked to exercise and human muscle respiration, perhaps revealing in some a hope rather than any understanding. The effects of alcohol on the human body was far better understood but although some descriptions were very detailed many were very vague, such as "it affects our minds" and "it damages the body". An often repeated erroneous idea was that "alcohol burns the liver (or other tissues and organs)"

Question 8

In **(a)(i)** two errors arose that have been identified elsewhere in this report, in that candidates did neither read the question clearly enough nor gave attention to the positioning of labels **A** and **B**. In the former case a number identified the type of vessel, artery and vein, but did not name them and in the latter case there were a significant number of responses with the correct names but linked to the wrong letter label. The function of the valve was regularly correctly identified but it was misnamed as either tricuspid or semilunar valve. Unfortunately there were candidates who expanded their responses about preventing backflow then incorrectly qualified this with phrases such as "to the ventricles". In ***Section (b)(i)*** many candidates quoted the maximum output of the heart, 14 dm^3 per minute, rather than the requested response, namely the maximum increase in heart output, 7 dm^3 per minute. Perhaps this is another example of lack of attention in reading the question. Far too many responses in **(b)(ii)** are worded as if the events mentioned do not occur before exercise rather than increasing during exercise, for example "now blood carries oxygen to the muscles because they start respiring". In **(c)** most candidates were well versed in the ways in which the risk of a blockage of the coronary artery could be reduced, although some discussed medical intervention which is curative rather than preventative. Far fewer appreciated that the blockage would lead to no flow of blood with oxygen and glucose to the tissue beyond **X** and thus the death of the tissue. Many responses simply identified the events as a heart attack or cardiac arrest and some used even more technical medical terms. Candidates should appreciate that a heart attack and a stroke are not synonymous.

Question 9

Although there were significant numbers of correct responses there were limited numbers who got all parts of **(a)** correct. There were sets of answers that revealed that candidates had little knowledge and understanding of the functions of the component parts of the digestive system and could identify them on the diagram. Candidates should be reminded that if the question requests a specific type of response, such as the relevant letter from a diagram as in section **(a)**, then responding with a name will not gain any credit. Part of the skill being tested was the ability to relate the function to a structure shown on the diagram. Responses in both ***Sections (b)*** and ***(c)*** followed this pattern of limited knowledge and understanding with many vague answers such as "the liver cleans the blood", or simply repetitions of the question such as "the liver digests and assimilates materials". Few seemed to realise that hydrochloric acid activates stomach proteases, kills bacteria and provides an optimum pH for enzyme activity in the stomach. Two common misconceptions about the liver were that it stores bile rather than produces it and that bile contains enzymes.

As part of CIE's continual commitment to maintaining best practice in assessment, CIE has begun to use different variants of some question papers for our most popular assessments with extremely large and widespread candidature, The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions are unchanged.

This change means that for this component there are now two variant Question Papers, Mark Schemes and Principal Examiner's Reports where previously there was only one. For any individual country, it is intended that only one variant is used. This document contains both variants which will give all Centres access to even more past examination material than is usually the case.

The diagram shows the relationship between the Question Papers, Mark Schemes and Principal Examiner's Reports.

Question Paper	**Mark Scheme**	**Principal Examiner's Report**
Introduction	Introduction	Introduction
First variant Question Paper	First variant Mark Scheme	First variant Principal Examiner's Report
Second variant Question Paper	Second variant Mark Scheme	Second variant Principal Examiner's Report

Who can I contact for further information on these changes?
Please direct any questions about this to CIE's Customer Services team at: international@cie.org.uk

BIOLOGY

Paper 0610/03

Extended Theory

General comments

Although there was a good spread of marks, there were fewer high scoring scripts than in previous sessions. **Question 5** proved the easiest question and **Question 3** the most difficult with very few candidates achieving maximum marks. **Question 4** also proved difficult. However, fewer marks were allocated for the more demanding question parts and this enabled weaker candidates to make a reasonable score. **Questions 1 (c)**, **1 (d)**, **2 (d)**, **3 (b)(ii)**, **3 (b)(iii)**, **4 (c)**, **4 (d)** and **6 (d)** proved somewhat difficult for many candidates. **Question 5** was answered especially well. In **Question 4 (d)** many candidates stated that oestrogen is used in fertility drugs. This was the most common error made by the candidates.

There was no evidence that any candidates failed to complete the paper in the allotted time. Weak candidates were often hampered by poor command of English as they often used inappropriate terms; for example, in **Question 2** the Examiners found 'antagonistic neurones' when the candidates should have been writing about antagonistic muscles. 'The neurone has to report at the central nervous system' conveys the right idea, but is not a suitable response and was not accepted for **Question 2 (c)(iv)**.

Comments on specific questions

Question 1

This proved to be a relatively easy opening question, although many candidates found it difficult to express correct ideas about antibiotic resistance in **(c)** and the advantages of using bacteria in genetic engineering in **(d)**.

(a) Most candidates found this part an easy start to the paper and correct responses in **(i)** were chloroplasts, nucleus and vacuole. Mitochondria were often seen as well. Some candidates were confused by the wording of the question and rather than giving features of a photosynthesising plant cell gave features that would not be found in a bacterial cell. The flagellum shown in Fig. 1.1 confused some candidates and they gave that as a feature found in plant cells. Chlorophyll, starch and sap were given quite frequently although candidates should know that these are not structures. Many did not qualify 'cell wall': to gain a mark they had to state that cell walls are made of cellulose. In part **(ii)**, most were able to identify cytoplasm and cell membrane as features found in both the liver cell and the bacterium. Several candidates gave 'granules' as one of their answers, but this was rejected in favour of 'glycogen granules'. 'Mitochondria' and 'DNA' without any further qualification were common errors here.

(b) Almost all candidates gave the name of two foods made by microorganisms. Bread, yoghurt, cheese and alcohol were favourites. Yeast was the most common mistake here. The Examiners also saw milk, protein, carbohydrate, butter and baby foods, none of which gained any credit. If candidates stated that enzymes extracted from bacteria were used to prepare baby foods then they would have gained credit. The Examiners were pleased to see mycoprotein and single cell protein; other interesting answers included tapai and tempe/tempeh from Indonesia and kimchee from Korea.

(c) Many candidates found this part difficult. There were three common mistakes:

- thinking that bacteria become *immune* to antibiotics;
- stating that bacteria gradually develop resistance;
- implying that antibiotics *cause* the resistance in the bacteria.

The Examiners looked to find a statement that the resistance was the result of mutation. This is an event unrelated to the use of antibiotics. They next looked for a statement that antibiotics kill all the bacteria except those that are resistant. Some candidates made it very clear that this was an example of selection or stated that the antibiotic is a selective agent. Many answers included the information that resistant bacteria reproduce and often ended by stating that the resistance is passed to the offspring. In many cases the answers were very poor with many candidates scoring no marks. Some confused antibiotic with antigen or antibody, but most frequent misconceptions were references to an incomplete course of treatment causing resistance; gradual development of resistance after exposure to antibiotics; bacteria 'learning' how to resist antibiotics; bacteria 'becoming used to' antibiotics. Weak candidates credited the bacteria with intent to change, or learning to cope or getting used to the antibiotic.

(d) This part proved quite difficult for many candidates. Some simply defined genetic engineering, few answered the question. However, many candidates stated that bacteria are involved in the production of insulin and their comments often implied that it is easy to insert a foreign gene into bacteria or that the bacteria can make a foreign protein. In some cases answers made it clear that both these things happen. Good candidates tended to mention plasmids and stated that they can be modified and are taken up by bacteria. The most common response, however, was the first one on the mark scheme: the fast reproduction rate.

Few candidates stated that bacteria can be used to clone genes as all the offspring from a genetically modified organism are identical. Some candidates thought that bacteria transfer genes into other organisms. Some thought that insulin could be injected into bacteria, others that genetically engineered bacteria could be inserted into humans to give them a continuous supply of insulin. In most cases marks were lost because answers were incomplete and were not qualified sufficiently to gain credit. Some really good candidates gave all the points on the mark scheme, but unfortunately there was no way the Examiners could award more than two marks. Candidates should always look carefully at the mark allocation and write accordingly. They are in danger of running out of time if they write too much for a short-answer question.

Question 2

This question was generally well answered by all candidates. It was pleasing to see that antagonistic muscle action is well understood.

(a) Almost all candidates gained two marks by stating two stimuli that are detected by sensory cells in the skin. Pain, touch and temperature were the most common responses.

(b) The answers to this question were given in Fig. 2.1 but this appeared to be too easy for some candidates who often gave a variety of incorrect responses to the first question. They stated, for example, that the cell body of the sensory neurone is in the muscles rather than in the ganglion. Some candidates did not understand the instruction to use the labels from the figure and labelled the cell bodies on the diagram. This was credited.

(c) The Examiners accepted a variety of terms for part **(i)**. The most common was 'electrical'. 'Electric current' was an occasional response and the Examiners accepted this although they did not accept 'electron flow' or 'electricity'. 'Nerve impulses' showed that candidates had not read the question carefully. Myelin and fatty sheath were the only two acceptable answers to part **(ii)**. Many candidates were not sure here and 'axon' and 'synapse' were found occasionally. Most candidates carried out the calculation successfully recording 75 metres per second as their answer in **(iii)**. This gained them two marks. Common errors were carrying out the calculation the wrong way around with time as the numerator and omitting the units. Synapse was the correct answer to part **(iv)** although answers revealed that many candidates did not understand transmission between neurones.

(d) Some candidates were confused by the positioning of the pin in Fig. 2.1. They assumed that if the hand was raised the pin would become impaled further in the skin of the hapless person. However, the majority realised in **(i)** that when an impulse travels to muscle **V** it will stimulate that muscle to contract to raise the forearm. Similarly, in **(ii)** the arm is lowered by the contraction of **W** and the relaxation of **V**. Many candidates used the term antagonistic in the correct context here. The Examiners made sure that candidates who *lowered the arm* in **(i)** were not penalised twice so they applied the 'error carried forward' rule and credited responses in **(ii)** that explained how the arm would be raised.

Question 3

This question on excretion and the kidney proved difficult for many including those who scored well on the rest of the paper.

(a) Candidates were expected to give a definition of excretion. The Examiners looked for three aspects:

- removal of waste products of metabolism;
- a reference to the toxic or harmful nature of these products;
- removal of substances excess to requirements, such as salts and water.

The complete definition as given in the syllabus was not found very often. Many candidates gave examples of substances that are excreted, but this was not demanded by the question and did not gain any marks. Examples often help to clarify candidates' answers if they are unclear; in this case the statements given above had to be clear and unambiguous to score marks and examples rarely helped to gain one of the three marks available. There was much confusion between excretion and egestion. 'Removal of waste' was a common answer but unsupported by any further explanation so it was not clear that this was *metabolic* waste. The concept of 'metabolism' is difficult for some candidates and so is the term. This resulted in some strange spellings and expressions. Perhaps candidates who struggle with terms could be taught that the substances excreted are made inside cells. Similarly 'in excess' could be rendered as 'when there is too much'.

(b) Most candidates were able to identify two of the three regions on the vertical section of the kidney successfully in part **(i)**. **F** proved the label that was the most difficult. Cortex was the correct answer; the Examiners looked for label lines that ended in the white area between the fibrous capsule (indicated by two lines around the outside of the drawing) and the stippled area which represents the medulla. Some candidates labelled the renal capsule and this was accepted. Label lines that ended anywhere else on the tubule were not. **R** was occasionally given as the renal vein as was **U**, but in most cases the label lines were in the correct places (renal artery and ureter).

Candidates found part **(ii)** particularly difficult. It was clear from **(i)** that they were unsure about the site of filtration and they were also unsure about what occurs. Some good, detailed, answers were seen but these were unusual. The Examiners looked for some statements about the movement of small molecules (not particles) from the blood through the walls of the capillaries. They also expected candidates to know about the role of blood pressure in filtration. Some candidates wrote about the glomerulus and this was accepted as an alternative to 'capillaries'. Candidates should know that filtration occurs through the walls of all capillaries (see ***Sections 7.2.2*** and ***7.2.3*** in the syllabus) and that this is the first stage in the formation of urine (see ***Section 9*** in the syllabus). Some candidates gave good accounts of reabsorption without first mentioning filtration. Many candidates were able to pick up marks here if they stated that blood is filtered and named two molecules that are reabsorbed. The Examiners assumed that any molecule reabsorbed must have been filtered first. Very few, if any, candidates mentioned the heart which is responsible for the high blood pressure.

It was not easy for candidates to organise their answers to part **(iii)** and some candidates made this question more difficult for themselves by writing lengthy answers when there were only short answer lines on the paper. The correct responses of 'diffusion' and 'active transport' for glucose and 'osmosis' for water were not seen very often. 'Selective reabsorption' was an acceptable alternative for glucose as was 'diffusion' for water. Osmoregulation was a common incorrect answer for osmosis.

Question 4

This question proved difficult for many candidates. This was particularly true of part **(d)**. Although most candidates organised their answers into two clear sections, some did not.

(a) Success was somewhat limited here as few candidates gained all four marks. Confusion between **E** and **F** and between **E** and **C** were the most frequent errors.

(b) In part **(i)**, the Examiners credited only the correct spelling of urethra. 'Ureter' was a common error. This was a rare case where only the correct spelling was accepted but the Examiners were pleased to find many more correct than incorrect answers. In part **(ii)**, the most common answers centred on difficulty in urinating or ejaculating. Some candidates thought that the urethra would be blocked, but this was not suggested by the question.

(c) proved quite problematic as there were so many situations that the candidates could choose to describe. The Examiners decided to award marks for the following:

- the choice of structure;
- the change that brings about a decrease in diameter;
- the consequence of that decrease.

The candidates were given a very wide scope here in choosing a circular or cylindrical structure to describe. Some decided to use the iris in the eye and described how the circular muscle in the iris contracts to reduce the size of the pupil. The most common response was probably the control of blood flow in the skin. To gain the first mark, candidates had to state that it is the *arterioles* that contract to reduce blood flow. Some lost the third mark because they stated that heat loss would be prevented rather than reduced or decreased. Common errors were to give occasions when the decrease was due to an abnormal event. Examples included references to surgical procedures, such as vasectomy and stomach stapling to treat obesity; fat deposits narrowing arteries causing blood clots and heart attacks were other answers that did not gain credit. The narrowing of the uterus due to the formation of the uterine lining was another example that the Examiners rejected as this does not involve muscle contraction.

(d) This was also a tricky question for candidates as they had to choose the hormone or hormones in both cases and then describe the correct function or functions. The Examiners were aware that there are a variety of hormones and a variety of ways in which they function as fertility drugs and to achieve birth control. Some answers were excellent, showing a very thorough understanding of the ways in which it is possible to intervene in the reproductive process. The Examiners gave some leeway with answers in which

- no hormone was named;
- a hormone was named but with an incorrect function;
- a hormone was named and a correct and an incorrect function were given.

The Examiners did their best to apply the marking points independently, but in some cases incorrect biology was given by the candidates and so marks were lost. The mark scheme needed to be quite exhaustive as the Examiners were unsure what examples would be given. They were prepared to accept substances that are strictly not hormones, such as clomiphene which blocks the action of oestrogen on the brain and the pituitary so releasing FSH from inhibition.

The Examiners were impressed by the detailed knowledge shown by some candidates about the use of FSH as a fertility drug and progesterone and oestrogen in contraceptive pills. Some candidates wrote about the action of these hormones in the control of reproduction and not in the context of hormones in fertility *drugs* and contraceptive *pills* or *implants*.

There was much confusion between ova, ovaries and ovules. Candidates should be careful about using these terms.

Question 5

This proved to be an accessible question for most candidates. Some had difficulty explaining the role of the control experiment (**B**) in part **(c)**.

(a) In part **(i)**, candidates had to link statements together. Many managed all four correctly. The difficult ones proved to be 'to soften the leaf' and 'to break down cell membranes' and candidates often confused those choosing the high temperature for the softening process after the decolourisation with alcohol. In part **(ii)**, many candidates stated that the presence of chlorophyll makes it difficult to see the colour change with iodine. Some stated that chlorophyll 'has starch' or 'has starch grains'.

(b) Almost all candidates gained two marks for stating the requirements for photosynthesis apart from carbon dioxide.

(c) Candidates often find it difficult to explain why a control is included in an experiment. There were one or two excellent answers seen here such as: 'to make sure the plant can photosynthesise under the bell jar', i.e. that the plant photosynthesises under the conditions of the experiment.

(d) Few candidates were very sure about this question. To gain a mark they had to state that destarching is carried out to make sure than any starch is made during the time when the plants were under the bell jar. There were many answers which went part way to stating this but were not precise enough to gain the mark. On the other hand there were many that made it clear that starch produced before the experiment would invalidate the finding of starch at the end. There were occasional excellent explanations.

(e) Answers to explanations in the tables were often very full. The mark for the first row was awarded if there was a reference to the absence of light or to the destarching process. However, the other two explanations were only awarded if there was reference to photosynthesis in the answers. In the second row, there was no carbon dioxide available. In the third row there was carbon dioxide, although many candidates stated that 'all the conditions for photosynthesis were present' and this was an acceptable alternative.

(f) To gain the first mark in this part, candidates had to state that photosynthesis does not occur in the dark. Some then stated that respiration occurs *instead* or *starts* and thus they lost the mark for respiration. There were also marks for stating that carbon dioxide is produced in the dark by the plant and that it is released or diffuses out of the plant. Most candidates understood this and gave good answers here.

Question 6

This question was generally answered well. It was a pleasure to mark some of the accounts of eutrophication in **(d)** as they were so clearly expressed.

(a) The candidates were asked for another definition here – this time of *ecosystem*. Some candidates defined a habitat instead because they referred to *an organism* instead of a community of organisms. Some candidates gave definitions of ecology rather than ecosystem. However, most candidates gave a satisfactory definition of this widely used term that implied that an ecosystem consists of organisms that interact with each other and/or with the physical environment in a defined place. The Examiners found quite a few 'non living organisms'.

(b) Most candidates found the appropriate answers to this question from the text and referred to food for humans and sport for tourists. Candidates lost marks if they did not qualify 'food' and 'sport' in their answers. Some thought that Nile perch were introduced to balance the ecology of Lake Victoria.

(c) As in June 2007, some candidates did not realise that this table should include more than one species. They often wrote one species in each row and this gained a maximum of one mark for giving algae as the producer.

(d) Knowledge of eutrophication seemed somewhat patchy. Some candidates gave very detailed answers gaining the four marks available very easily. These were splendid answers. Other candidates did not realise that eutrophication leads to the death and decomposition of plants so that the oxygen concentration of the water decreases. Instead they wrote about the loss of algae as food for cichlid fish or predation by the Nile perch.

BIOLOGY

Paper 0610/03

Extended Theory

General comments

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(c) Many candidates found this part difficult. There were three common mistakes:

- thinking that bacteria become *immune* to antibiotics;
- stating that bacteria gradually develop resistance;
- implying that antibiotics *cause* the resistance in the bacteria.

The Examiners looked to find a statement that the resistance was the result of mutation. This is an event unrelated to the use of antibiotics. They next looked for a statement that antibiotics kill all the bacteria except those that are resistant. Some candidates made it very clear that this was an example of selection or stated

that the antibiotic is a selective agent. Many answers included the information that resistant bacteria reproduce and often ended by stating that the resistance is passed to the offspring. In many cases the answers were very poor with many candidates scoring no marks. Some confused antibiotic with antigen or antibody, but most frequent misconceptions were references to an incomplete course of treatment causing resistance; gradual development of resistance after exposure to antibiotics; bacteria 'learning' how to resist antibiotics; bacteria 'becoming used to' antibiotics. Weak candidates credited the bacteria with intent to change, or learning to cope or getting used to the antibiotic.

(d) This part proved quite difficult for many candidates. Some simply defined genetic engineering, few answered the question. However, many candidates stated that bacteria are involved in the production of insulin and their comments often implied that it is easy to insert a foreign gene into bacteria or that the bacteria can make a foreign protein. In some cases answers made it clear that both these things happen. Good candidates tended to mention plasmids and stated that they can be modified and are taken up by bacteria. The most common response, however, was the first one on the mark scheme: the fast reproduction rate.

Few candidates stated that bacteria can be used to clone genes as all the offspring from a genetically modified organism are identical. Some candidates thought that bacteria transfer genes into other organisms. Some thought that insulin could be injected into bacteria, others that genetically engineered bacteria could be inserted into humans to give them a continuous supply of insulin. In most cases marks were lost because answers were incomplete and were not qualified sufficiently to gain credit. Some really good candidates gave all the points on the mark scheme, but unfortunately there was no way the Examiners could award more than two marks. Candidates should always look carefully at the mark allocation and write accordingly. They are in danger of running out of time if they write too much for a short-answer question.

Question 2

(a) Part **(i)** proved straightforward for most candidates although a few omitted to state that salivary glands make, release, secrete or produce saliva. The points about salivary amylase appeared in most scripts. Some candidates stated that amylase digests glucose. Some also wrote about swallowing but the question specifically referred to *in the mouth*.

In part **(ii),** most candidates stated that molar teeth grind food into smaller particles, although some did not mention the reduction in particle size. Many then stated that the surface area of the food is increased for enzyme action. Some stated that food *molecules* are reduced in size and they lost these marks.

(b) Candidates tended to lose marks here because they were not precise enough with their answers. Many knew that bacteria and acids are involved in tooth decay; many wrote about plaque on the surface of teeth. However, to gain marks candidates had to state that bacteria feed or respire sugar and produce acids that dissolve tooth enamel; these points, especially the last, were not seen very often.

(c) Candidates who knew that fluoride is involved with strengthening enamel easily gained the mark available here. Many candidates gave incorrect answers about neutralising acids in the mouth or 'fighting bacteria'.

(d) Fluoridation of water supplies is a controversial topic. Some candidates had obviously discussed the arguments for and against this issue, but rarely did they gain full marks for three clear statements. Useful information can be found at:

http://www.fluorideinformation.com
http://www.bfsweb.org
http://www.cdc.gov/fluoridation
http://www.fluoridealert.org

These will give candidates information on both sides of the argument.

Question 3

This question on excretion and the kidney proved difficult for many including those who scored well on the rest of the paper.

(a) Candidates were expected to give a definition of excretion. The Examiners looked for three aspects:

- removal of waste products of metabolism;
- a reference to the toxic or harmful nature of these products;
- removal of substances excess to requirements, such as salts and water.

The complete definition as given in the syllabus was not found very often. Many candidates gave examples of substances that are excreted, but this was not demanded by the question and did not gain any marks. Examples often help to clarify candidates' answers if they are unclear; in this case the statements given above had to be clear and unambiguous to score marks and examples rarely helped to gain one of the three marks available. There was much confusion between excretion and egestion. 'Removal of waste' was a common answer but unsupported by any further explanation so it was not clear that this was *metabolic* waste. The concept of 'metabolism' is difficult for some candidates and so is the term. This resulted in some strange spellings and expressions. Perhaps candidates who struggle with terms could be taught that the substances excreted are made inside cells. Similarly 'in excess' could be rendered as 'when there is too much'.

(b) Most candidates were able to identify two of the three regions on the vertical section of the kidney successfully in part **(i)**. **F** proved the label that was the most difficult. Cortex was the correct answer; the Examiners looked for label lines that ended in the white area between the fibrous capsule (indicated by two lines around the outside of the drawing) and the stippled area which represents the medulla. Some candidates labelled the renal capsule and this was accepted. Label lines that ended anywhere else on the tubule were not. **R** was occasionally given as the renal vein as was **U**, but in most cases the label lines were in the correct places (renal artery and ureter).

Candidates found part **(ii)** particularly difficult. It was clear from **(i)** that they were unsure about the site of filtration and they were also unsure about what occurs. Some good, detailed, answers were seen but these were unusual. The Examiners looked for some statements about the movement of small molecules (not particles) from the blood through the walls of the capillaries. They also expected candidates to know about the role of blood pressure in filtration. Some candidates wrote about the glomerulus and this was accepted as an alternative to 'capillaries'. Candidates should know that filtration occurs through the walls of all capillaries (see ***Sections 7.2.2*** and ***7.2.3*** in the syllabus) and that this is the first stage in the formation of urine (see ***Section 9*** in the syllabus). Some candidates gave good accounts of reabsorption without first mentioning filtration. Many candidates were able to pick up marks here if they stated that blood is filtered and named two molecules that are reabsorbed. The Examiners assumed that any molecule reabsorbed must have been filtered first. Very few, if any, candidates mentioned the heart which is responsible for the high blood pressure.

It was not easy for candidates to organise their answers to part **(iii)** and some candidates made this question more difficult for themselves by writing lengthy answers when there were only short answer lines on the paper. The correct responses of 'diffusion' and 'active transport' for glucose and 'osmosis' for water were not seen very often. 'Selective reabsorption' was an acceptable alternative for glucose as was 'diffusion' for water. Osmoregulation was a common incorrect answer for osmosis.

Question 4

This question proved difficult for many candidates. This was particularly true of part **(d)**. Although most candidates organised their answers into two clear sections, some did not.

(a) Success was somewhat limited here as few candidates gained all four marks. Confusion between **E** and **F** and between **E** and **C** were the most frequent errors.

(b) In part **(i)**, the Examiners credited only the correct spelling of urethra. 'Ureter' was a common error. This was a rare case where only the correct spelling was accepted but the Examiners were pleased to find many more correct than incorrect answers. In part **(ii)**, the most common answers centred on difficulty in urinating or ejaculating. Some candidates thought that the urethra would be blocked, but this was not suggested by the question.

(c) proved quite problematic as there were so many situations that the candidates could choose to describe. The Examiners decided to award marks for the following:

- the choice of structure;
- the change that brings about a decrease in diameter;
- the consequence of that decrease.

The candidates were given a very wide scope here in choosing a circular or cylindrical structure to describe. Some decided to use the iris in the eye and described how the circular muscle in the iris contracts to reduce the size of the pupil. The most common response was probably the control of blood flow in the skin. To gain the first mark, candidates had to state that it is the *arterioles* that contract to reduce blood flow. Some lost the third mark because they stated that heat loss would be prevented rather than reduced or decreased. Common errors were to give occasions when the decrease was due to an abnormal event. Examples included references to surgical procedures, such as vasectomy and stomach stapling to treat obesity; fat deposits narrowing arteries causing blood clots and heart attacks were other answers that did not gain credit. The narrowing of the uterus due to the formation of the uterine lining was another example that the Examiners rejected as this does not involve muscle contraction.

(d) This was also a tricky question for candidates as they had to choose the hormone or hormones in both cases and then describe the correct function or functions. The Examiners were aware that there are a variety of hormones and a variety of ways in which they function as fertility drugs and to achieve birth control. Some answers were excellent, showing a very thorough understanding of the ways in which it is possible to intervene in the reproductive process. The Examiners gave some leeway with answers in which

- no hormone was named;
- a hormone was named but with an incorrect function;
- a hormone was named and a correct and an incorrect function were given.

The Examiners did their best to apply the marking points independently, but in some cases incorrect biology was given by the candidates and so marks were lost. The mark scheme needed to be quite exhaustive as the Examiners were unsure what examples would be given. They were prepared to accept substances that are strictly not hormones, such as clomiphene which blocks the action of oestrogen on the brain and the pituitary so releasing FSH from inhibition.

The Examiners were impressed by the detailed knowledge shown by some candidates about the use of FSH as a fertility drug and progesterone and oestrogen in contraceptive pills. Some candidates wrote about the action of these hormones in the control of reproduction and not in the context of hormones in fertility *drugs* and contraceptive *pills* or *implants*.

There was much confusion between ova, ovaries and ovules. Candidates should be careful about using these terms.

Question 5

Candidates found the first two parts of this question very difficult, but part **(d)** on the miniature respirometer was much more accessible; there were many good descriptions of how to use the respirometer.

(a) This proved very difficult for candidates. The Examiners expected candidates to refer to the exchange of gases between organisms and their surroundings. In many cases the phrase 'gas exchange' was defined in terms of diffusion of oxygen and carbon dioxide, but answers did not specify exchange with the environment or with air or water. Instead the answers could have referred to diffusion *inside the organism* between cells and tissue fluid or between cells and the blood. As these answers were ambiguous they did not gain credit.

(b) This question also proved difficult for candidates. 'Large surface area' was seen quite often, but was not appropriate as this was not visible in Fig. 5.1. Good answers stated that there was only one layer of cells and that this was a thin layer. The role of the mucus layer in allowing oxygen to dissolve was rarely seen; most candidates described diffusion through this layer and did not gain credit.

(c) In part **(i)**, many candidates stated that water would be used in photosynthesis. Many, however, gave good answers such as 'activation of enzymes'. A common error in part **(ii)** was to state that energy is required for movement. Most candidates gave 'for growth' as their answer here.

(d) Answers to part **(i)** were generally very good. Most candidates were able to gain all three marks by using the information in the question stem about soda lime. However, some answers were not clear about 'tubes' as there was some confusion between the boiling tube and the capillary tube. 'It moves along the tube' was not a correct response. Part **(ii)** gave the candidate scope to explain how the apparatus would be used to measure the effect of temperature on the rate of respiration. Most candidates gave a suitable temperature range, described how they would take measurements and explained that each result should be repeated. Many, however, did not state how they would calculate the *rate* of respiration as required by the question. In most cases where this was done an equation was given. A few candidates stated that the position of the meniscus would be plotted on a graph and the gradient would be used to calculate the rate. In part **(iii)**, few stated clearly that respiration is controlled by enzymes. Many knew that enzyme activity is influenced by temperature and 'denatured at high temperature' was a common response.

Question 6

This question was generally answered well. It was a pleasure to mark some of the accounts of eutrophication in **(d)** as they were so clearly expressed.

(a) The candidates were asked for another definition here – this time of *ecosystem*. Some candidates defined a habitat instead because they referred to *an organism* instead of a community of organisms. Some candidates gave definitions of ecology rather than ecosystem. However, most candidates gave a satisfactory definition of this widely used term that implied that an ecosystem consists of organisms that interact with each other and/or with the physical environment in a defined place. The Examiners found quite a few 'non living organisms'.

(b) Most candidates found the appropriate answers to this question from the text and referred to food for humans and sport for tourists. Candidates lost marks if they did not qualify 'food' and 'sport' in their answers. Some thought that Nile perch were introduced to balance the ecology of Lake Victoria.

(c) As in June 2007, some candidates did not realise that this table should include more than one species. They often wrote one species in each row and this gained a maximum of one mark for giving algae as the producer.

(d) Knowledge of eutrophication seemed somewhat patchy. Some candidates gave very detailed answers gaining the four marks available very easily. These were splendid answers. Other candidates did not realise that eutrophication leads to the death and decomposition of plants so that the oxygen concentration of the water decreases. Instead they wrote about the loss of algae as food for cichlid fish or predation by the Nile perch.

BIOLOGY

Paper 0610/04

Coursework

General comments

The standard of work in the samples from many Centres continues to be high. It is especially pleasing to see candidates given space to demonstrate their abilities in the more challenging aspects of skills C3 and C4, where many rise to the occasion and show high levels of achievement in planning experiments and discussing the reliability of their results.

Almost all Centres now recognise the importance of designing quantitative tasks for the majority of their assessments. This gives candidates the opportunity to collect and record numerical results, to process them and display them as graphs, and to comment on the main sources of error. The latter is a high-level skill and this frequently differentiates between candidates working at the highest levels within this skill area and those who are not quite there yet. Weaker candidates may not be able to identify sources of error at all, or do so indiscriminately, listing everything they can think of without making judgments about which ones are genuinely important.

Quantitative tasks are most easily developed within the topics of enzymes, respiration, photosynthesis, osmosis, transpiration and germination. However, many Centres also provide candidates with opportunities for careful observation and recording by means of diagrams, an important skill within Biology. Here, leaf structure, flower structure, fruit structure and simple dissections (for example of a heart) appear most frequently.

Group work occasionally causes some difficulties. Group work is an excellent way of developing the four practical skills, and all candidates – however weak or strong – benefit considerably from discussing their ideas with others. However, for the purposes of assessment it is essential that the teacher can guarantee that the submitted work is the candidate's own, with no input from anyone else. This cannot be so if, for example, a plan that is assessed for C4 has been discussed as a class or within a group. Work that is assessed for submission for Paper 4 must be individual work. An exception is if results are collected as a group exercise, or as part of a demonstration; here, it is possible for candidates to take the results away and work on them individually for a C3 assessment.

Another issue that sometimes arises is inadequately marked work. The Moderators need to see the candidates' original work, not a fair copy – and this work needs to be fully marked by the teacher. It should be marked in the normal way, with errors pointed out, comments made where something is done well and suggestions made about how the candidate could improve what he or she has done. The candidate will benefit from this feedback, and it greatly helps the Moderators to see how and why a particular mark has been awarded.

Some Centres are much better than others at organising and labelling the various components of their sample. In a few cases, considerable detective work is needed to work out which experiment, which skill and which mark relates to a particular piece of work provided within the sample. It is very helpful if each piece of work is fully labelled with the experiment title and number (matching the list on the Experiment Form) as well as the skill or skills assessed and the marks awarded.

BIOLOGY

Paper 0610/05

Practical Test

General comments

Once again, a significant number of Centres did not submit Supervisor's Reports or a seating plan, although fewer than in previous sessions.

The Supervisor's Reports are an invaluable resource to Examiners in assessing the work of candidates. It could be the case that an experiment or material behaved in a way that was not anticipated or that candidates were supplied with a specimen that had features that were not expected and so had not been considered in the mark scheme. Under such circumstances, candidates can gain credit for what they could do and observe, even if the material had looked or behaved in an unexpected way. Examiners find that any additional information can be helpful, so Centres should include any information that they feel would be of assistance, even if it is not specifically requested. Identification and/or drawing of specimens supplied to the candidates is always a good idea. Some Centres in the past have supplied photographs of specimens and test results, both of which were useful. It should be noted that the Supervisor's Report form is now found in the Confidential Instructions rather than the question paper itself.

If any difficulty is experienced in supplying suitable material or if there are any queries concerning how the material should be presented to the candidates, Centres should contact CIE for advice, preferably in good time before the date of the examination.

Comments on specific questions

Question 1

(a) (i) Good, clearly presented table formats are a relatively easy way to gain marks. Centres are advised to encourage their candidates to design tables for the results of their practical work, giving them the opportunity to design appropriate tables, with suitable headings and units, for a range of requirements. Candidates should gain experience in looking at the questions and deciding which particular headings are required. In this way, they can develop the ability to decide how best to display the information. Some very untidy tables were seen, with incomplete borders, and candidates were frequently unable to include a suitable heading to indicate the time taken for the film to clear.

(ii) Most candidates were able to record a time for the reaction for the two different pH solutions. Difficulty arose when candidates were unable to distinguish between seconds and decimal fractions of a minute. For example, 1:30 on a stopwatch is 1.5 minutes and not 1.3 minutes. Some candidates gave completely unrealistic times, such as 1.45 seconds. For some candidates, the photographic film did not clear during the observed time. In such a case, the candidate should indicate this.

(b) (i) The answers to this part of the question often failed to score full marks, although well-prepared candidates were able to do so. Although most candidates were designing a line graph rather than a bar chart, many plotted the data with the axes the wrong way round. It should be remembered that the independent variable (the variable that is being changed by the design of the experiment, in this case the pH) should be on the x axis while the dependent variable (the variable that produces the result each time, in this case the time taken to clear the photographic film) should be on the y axis. Each axis should be labelled, with units where appropriate. The scale should be regularly spaced, with 0 indicated. The mark was frequently not awarded for the scale, as 0 was not indicated and the 'time taken' axis tended to be labelled as 0.5, 2, 8 and 12 for successive grid lines. Candidates were expected to join the plotted points with a ruled line from point to point.

(ii) Most candidates were able to indicate that low and high pH values resulted in decreased enzyme activity or increased time for the photographic film to clear.

(iii) Some candidates experienced problems plotting their data, as they did not realise that tube A contained the solution at pH 8 while tube B contained the solution at pH 4. They were often reversed. Some had also not planned ahead and therefore did not use scales that allowed them to plot times above 12 minutes even though the time taken in their experiment was longer. Their own data could not, therefore, be plotted unless they redrew the graph. As some had completed the graph in pen, this was difficult.

(iv) A common incorrect response was that 'I carried out the experiment at different pH values'. This was the whole point of the experiment. Candidates were expected to state clearly that the two experiments differed in an appropriate way, such as being carried out at different temperatures, different volumes or concentrations of the enzyme used, a different enzyme used, different photographic film or different sized pieces of photographic film.

(c) Few candidates scored well in this part of the question. When asked to suggest how to carry out an investigation, candidates should be as specific as possible. In this case, the need for the same volumes of enzyme in each test tube, the same concentration of enzyme, the same or optimum pH in each test tube and correct reference to the substrate, such as photographic film, is essential. Theoretical explanations of the effect of temperature on the rate of enzyme activity, or hypothetical results, are not required.

Question 2

(a) (i) The candidates who had experience of handling and drawing specimens answered the whole of part **(a)** well. The quality of drawing was, in many cases, poor. Candidates should be reminded that biological diagrams should not be drawn in pen or biro. The drawing should be large, clear and have a clear outline rather than a sketchy outline. Even an unlabelled drawing here would have scored two marks. Label lines should point clearly to the structure concerned and should not cross each other.

(ii) Having just drawn the lower surface of the leaf, some candidates did not read the question carefully enough and were apparently referring to the lower surface when they did not state clearly to which surface they were referring. In a question of this type, candidates should be making a comparison between the two surfaces, either explicitly or by implication. Suitable comments would be 'the upper surface is shinier' or 'the upper surface is shiny and the lower surface is dull'.

(b) (i) Candidates were expected to count the whole number of squares covered by the outlines of the leaf. They were then expected to account, in a reasonable way, for the partially covered squares. Some candidates spoilt an otherwise good answer by not giving their answer to the nearest cm^2.

(ii) Some explanations were not precise enough to describe exactly how to ensure that the answer was as accurate as possible. A significant number of candidates simply stated that they would measure the length and width accurately and then multiply them together. This method is not appropriate for an irregularly shaped object.

(c) (i) The question referred to the *surfaces*, so candidates were expected to comment on the presence or absence of bubbles on each surface. In those cases where the Supervisor had indicated that bubbles did not appear (even though they might have been expected) it was possible to credit alternative answers.

(ii) Once again, candidates needed to distinguish between the distribution of stomata on the upper and lower surfaces. Few candidates referred to the presence of air within the leaf and its expansion and escape through the stomata when heated.

(d) (i) Candidates experienced difficulty with this question. Many identified the cells as various types of mesophyll cell and there was some confusion between guard cells and stomata. Some even suggested blood cell types.

(ii) Similarly, many candidates circled epidermal cells and therefore were not credited with the mark, even if they had also circled guard cells. The mark was only given if *only* guard cells were circled.

(e) Few candidates scored well in this part of the question. Many suggested immersing the leaf in water and counting the number of bubbles. As more than one bubble could come out of each stomatal pore, this was not considered to be a valid suggestion. Even those who were suggesting looking at a section of leaf under the microscope and then multiplying up to the surface area of the leaf did not explain this method clearly and so did not score well.

BIOLOGY

Paper 0610/06
Alternative to Practical

General comments

Overall, the paper produced almost the full range of marks out of 40, though marks on some parts of the questions were gained only by able candidates and therefore discriminating. It was not obvious that candidates were unable to attempt to answer all of the questions nor that there was insufficient time for the paper to be completed in the hour allowed. The last page **Question 3(c)** was noted to be left unanswered on some scripts but most candidates followed the instruction to turn over the page for this last section. This paper was comparable to the paper for last year in terms of difficulty. Drawing skills were good; many of the drawings showed the detail of veins in the leaf but other drawings were poor. There were parts of some questions based on investigative and planning skills (C4), which some candidates found difficult and perhaps require further practise. There was evidence that some candidates had not experienced some of the practical techniques such as photomicrographs of leaf lower epidermis and calculating the number of stomata so their answers were based on general biological knowledge.

Candidates should be made aware of the differences in responses that they should make when questions involve terms such as 'describe' and 'explain'. One of the problems seemed to be candidates giving descriptions when explanations had been requested or just describing or explaining and not both.

Comments on specific questions – all questions to be attempted

Question 1

The question was based on the effect of pH on the activity of trypsin, a protease, on the breakdown of the protein holding the photographic film on the plastic backing.

(a)(i) There were many well constructed graphs although few gained full marks. The rubric required plotting the data in the table for student 2 *only* - several candidates failed to read the question carefully. A few candidates realised this point and because the graph had been drawn in ink instead of pencil, they were unable to correct this error other than to cross out the second line. Orientation of the axes was correctly shown in most graphs with pH on the horizontal (x) axis but it was the labelling of the axes where errors were introduced. The labelling for the axes should follow the column headings in the Table 1.1 and many errors were made in ph, PH, or Ph on the x axis with the y axis time only without units. The grid 14 cm x 15 cm allowed scales to be easily selected and many candidates used most of the printed area. Plots were generally accurate. The construction of the line joining the points by use of a ruler was completed by many candidates though some freehand curves were inaccurate and missed points. Some candidates extrapolated the line (below pH 2 and beyond pH 10) for which there was no data. Only a few bar charts were noted.

(ii) Candidates did not read the command words to this part of the question – 'describe and explain'. Many described the effect of pH on the activity of the enzyme but did not attempt to explain the reason for this effect.
For the description, the optimum value was given, although several candidates incorrectly referred to pH 8 as neutral. Either side of pH 8 the activity was slower, showing that the extremes of pH have an effect on this enzyme. Credit was given if figures were read off from the graph and used to support this idea.
For the explanation, the idea that the enzyme was denatured (not 'killed') and that the substrate did not combine or fit into the active site because the shape of the enzyme was affected.
Unfortunately, some candidates incorrectly reversed the interpretation of the data and considered that the activity of the enzyme was slowest at pH 8 and faster at the extremes.

(b) (i) The able candidate who appreciated the effect of pH answered this part easily, based on the possible differences in temperature, concentration and volume of enzyme, size and type of photographic film or possible variation in buffer solutions or contamination of apparatus.
Errors were noted to vague references to 'solutions' which might mean enzyme, buffer or contaminants.

(ii) This part of the question was based on planning details to ensure that the results were as accurate as possible. Repeating the recordings was the usual point described by candidates followed by controlling the volumes or concentration of enzyme solutions, areas of film, or checking the pH of the buffer. Increasing the range of pH buffer solutions to include intermediate values such as pH 7, stirring the mixtures to avoid settling, cleaning the apparatus before use, were points mentioned by a few candidates.
Common errors notes included: stating use of 'constant' temperature or 'accurate' concentrations rather than the same; giving detailed descriptions of how to time the experiment more accurately; outlining the procedure for the experiment in step by step detail stressing the need to be careful at each stage; describing how to obtain a more precise end point occasionally using the biuret test to check for the presence of protein.

Question Two

(a) The leaf shown in Fig. 2.1 was the lower surface of a simple dicotyledonous leaf. The veins and midrib were clearly shown and there was a small toothed margin. This question based on a labelled drawing, interpreting the leaf shown, was well answered by some candidates. Drawings by other candidates were rushed, lacked detail e.g. smooth edges and incorrectly positioned veins and the size did not follow the rubric to be constructed the same size. A few candidates constructed the grid around the leaf as shown but some did not use this as a guide for the size.
Many drawings did not attempt to show accurately the margin or the pattern of the veins. Less shading was seen than in former drawings. The outlines were often clear and less sketchy. Some candidates did attempt labels but many drawings were left unlabelled. Some labels were relevant but others were incorrect.

(b) (i) Many candidates calculated the surface area of the leaf within the accepted range. It is not possible to obtain the area by multiplying the width by the length because of the angle and curve of the lamina or leaf blade.

(ii) The able candidate was able to gain full marks here, others had the right idea but found it hard to explain. The technique of marking the squares on the leaf was quite well known and enabled these candidates to count the number of full squares and to group the partly full squares. A small number of candidates had made creditworthy attempts at dividing the leaf into triangles and rectangles and had calculated areas within the range.

(c) (i) Many able candidates correctly labelled epidermal and guard cells. There were many incorrect answers seen including palisade mesophyll, spongy mesophyll, xylem or phloem, 'plant cell' and 'animal cell', epithelial cells. Common errors noted referred to either the label of a guard cell as a stoma or label the stoma as a guard cell.

(ii) Only a few able candidates correctly ringed two cells where chloroplasts were to be found, that is one pair of guard cells or often two individual guard cells. Overall, however, this section was poorly answered, candidates either circling two epidermal cells or two sets of guard cells (4 cells). Other candidates labelled two guard cells and an epidermal cell (3 cells).

(d) The able candidates, especially those who had experience of microscopic techniques, selected a specific area, described how to calculate the number of stomata in this area and then to calculate the number for the entire leaf. Quite a number of candidates chose a section 1 cm^2 and so made the calculation straightforward. There were very few references to use nail varnish or to obtain an epidermal peel though some candidates did try to use the photograph, Fig. 2.2. Some of these candidates were confused with the magnification and thought they could just multiply the number of stomata by 145. Some other candidates used a section of the leaf but did not know how to calculate the total number of stomata.
Unfortunately, there were several candidates who described experiments involving counting transpiration bubbles or using cobalt chloride paper which would not give numerical data.

Question Three

This question was based on the Mendelian inheritance of the gene to produce chlorophyll in tobacco seedlings.

(a) This first section was well answered and was based on counting the numbers of seedlings in two dishes and recording the numbers in a table. Unfortunately, the table showed those candidates who did not have mathematical skills for adding the numbers in the third (total) row of the table and a few candidates entered results across the rows instead of down the columns.

(b) Although many candidates were able to refer to the 'green' allele as dominant, the 'white' allele was infrequently referred to as recessive. The able candidate did use the word allele but this was uncommon and 'dominant' was often accompanied by totally wrong or inappropriate terms such as phenotype, homozygous, heterozygous, genotype, seedlings etc. Only a few of the able candidates referred to the 3:1 ratio for 'green/'white'. Many candidates simply quoted the figures and did nothing with them. The common error was to state that the 'green' was dominant because there were more green seedlings. A small number of good candidates correctly identified the heterozygous parents.

(c) This question, based on the survival of the green seedlings because they were able to photosynthesise, was well answered by candidates. Common errors noted included 'green' seedlings survived because there were more of them; ' green ' was dominant and to link this to survival; 'white' because there were less of them and so there was less competition; both types because both could make food (not glucose), etc. A few candidates did not answer this part; perhaps they failed to turn over the page and did not see the question.