BIOLOGY

Paper 0610/11
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**D**	21	**C**
2	**D**	22	**A**
3	**B**	23	**C**
4	**D**	24	**D**
5	**A**	25	**C**
6	**A**	26	**C**
7	**A**	27	**C**
8	**C**	28	**B**
9	**D**	29	**A**
10	**B**	30	**A**
11	**D**	31	**D**
12	**B**	32	**D**
13	**D**	33	**A**
14	**B**	34	**A**
15	**C**	35	**D**
16	**B**	36	**C**
17	**B**	37	**A**
18	**A**	38	**B**
19	**D**	39	**A**
20	**B**	40	**A**

General comments

There was a satisfactory mix of questions with few that were either too difficult or too easy to make a valid overall contribution to the test. There was some evidence that candidates occasionally committed themselves to an answer before they had thought carefully enough about what was being asked.

Comments on individual questions

Question 7

This was most competently answered by the vast majority of candidates, making it one of the easiest questions on the paper. It may be that its facility was enhanced by the comparative implausibility of the distractors.

Question 14

This was the easiest question on the paper, but, unlike many questions that are correctly answered by a large proportion of the candidates, this one proved unusually reliable at discriminating between candidates at the lower end of the ability range.

Question 16

This question became largely a choice between options **B** and **C**. It is very possible that those who opted incorrectly for **C** did so because they confused the names of the aortic and bicuspid valves rather than failing to understand the way in which the heart operates.

Question 18

Two thirds of candidates failed to link their own experience with the information on the graph. If they had been a little more thoughtful, they would surely have realised that they do not begin to breathe more quickly immediately they start vigorous exercise, but a short time afterwards.

Question 19

This question exposed a serious misunderstanding, with well over half the candidates believing that carbon dioxide as well as lactic acid is produced as a result of anaerobic respiration in muscles.

Question 20

Here, some of the more able candidates were guilty of not thinking carefully enough and thus they did not take into account the fact that the oxygen taken in and the carbon dioxide released during respiration are equal in volume, causing the liquid marker to remain in the same place.

Question 29

There are always candidates who struggle with genetics questions, but this one was very straightforward. Only the least plausible of the options failed to attract a significant number of candidates, suggesting that there was a sizeable degree of guesswork employed.

Question 36

This was another question that did not appear truly to reflect the abilities of the candidates. Most, if asked, would be likely to state that carbon dioxide and water are products of respiration, and it is thus surprising that this was not carried through to realising that the products of respiration are involved in the carbon *and* the water cycles. It was also a little disturbing to note that over a third of the candidates opted for 'the energy cycle' indicating a failure to appreciate the non-cyclic nature of energy flow.

BIOLOGY

Paper 0610/12
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**A**	21	**C**
2	**A**	22	**D**
3	**C**	23	**C**
4	**D**	24	**A**
5	**B**	25	**C**
6	**D**	26	**B**
7	**D**	27	**C**
8	**B**	28	**C**
9	**A**	29	**A**
10	**D**	30	**D**
11	**B**	31	**A**
12	**C**	32	**A**
13	**B**	33	**D**
14	**D**	34	**C**
15	**D**	35	**A**
16	**B**	36	**B**
17	**B**	37	**D**
18	**B**	38	**A**
19	**D**	39	**A**
20	**A**	40	**A**

General comments

There was a satisfactory mix of questions with few that were either too difficult or too easy to make a valid overall contribution to the test. There was some evidence that candidates occasionally committed themselves to an answer before they had thought carefully enough about what was being asked.

Comments on individual questions

Question 2

This was most competently answered by the vast majority of candidates, making it one of the easiest questions on the paper. It may be that its facility was enhanced by the comparative implausibility of the distractors.

Question 9

Candidates may have been unfamiliar with the thickened form of the inner wall of guard cells, leading them to believe that this particular structure was the one that was incorrectly labelled. Unfortunately, that would also indicate that they were unfamiliar with the correct location of the cell membrane.

Question 11

This was the easiest question on the paper, but, unlike many questions that are correctly answered by a large proportion of the candidates, this one proved unusually reliable at discriminating between candidates at the lower end of the ability range.

Question 16

This question became largely a choice between options **B** and **C**. It is very possible that those who opted incorrectly for **C** did so because they confused the names of the aortic and bicuspid valves rather than failing to understand the way in which the heart operates.

Question 19

This question exposed a serious misunderstanding, with almost a half of the candidates believing that carbon dioxide as well as lactic acid is produced as a result of anaerobic respiration in muscles.

Question 20

Just over 50% of the candidates failed to link their own experience with the information on the graph. If they had been a little more thoughtful, they would surely have realised that they begin to breathe more quickly not immediately they start vigorous exercise, but a short time afterwards.

Question 26

A rather disturbing number of candidates felt that carbon dioxide is necessary for germination. The diagram clearly showed that the changes were taking place very largely underground; thus photosynthesis was not likely to be involved.

Question 31

There are always candidates who struggle with genetics questions, but this one was very straightforward. Only the least plausible of the options failed to attract a significant number of candidates, suggesting that there was a degree of guesswork employed.

Question 38

Although this proved to be a relatively easy question, there was a minor degree of confusion over exactly where the sunlight energy entered the food chain. Certainly, no candidate was attracted by the possibility of a top carnivore being a producer, since none opted for **D.**

BIOLOGY

Paper 0610/02

Core Theory

General comments

This year, as in the two previous years, there were a significant number of candidates who failed to attempt every part of all questions, but this year this appeared to be linked to candidates being seemingly inadequately prepared for the demands of some of the questions, rather than having had insufficient time to complete the paper. There were candidates who showed very limited knowledge and understanding of some topics from the syllabus. There was 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 that candidates continue to have certain misconceptions and misunderstandings. The questions in which candidates were asked to make predictions, however, were answered with greater skill. There was considerable evidence over a range of questions, indicated in the specific question comments, that candidates had not read the questions with sufficient care and thus their responses were inadequate or off the point, despite being sometimes biologically correct. There was also evidence that a growing number of candidates ignored the instructions given for their guidance in particular questions, thereby reducing the potential marks that they could be awarded for these questions. Candidates should be made aware of the need to read the questions carefully and to take note of each question's demands. Examiners will take account of the responses in the numbered spaces printed on the paper and will only take account of additional responses if a numbered space is left blank or is clearly a replacement for an answer already written in one of the numbered spaces.

There seemed to be a larger incidence this year of candidates altering their responses. Candidates should be encouraged to make it very clear which response is the answer that they want marked, especially if it is not written in the designated answer space. There was a noticeable deterioration in the clarity of candidates' handwriting, making it very difficult at times for the reader to be certain what the candidate had written, and thus there was the potential for candidates to deny themselves some potential credit.

Comments on specific questions

Question 1

Responses showed that a significant number of candidates did not understand the term *vertebrate,* as their answers included groups of invertebrates, often molluscs or arthropod sub-groups, with a few candidates completing the paragraph entirely with invertebrate groups. Although most identified 'birds' as the second response, some also gave this as the third response. The first and last responses, 'reptiles' and 'amphibians', were frequently transposed. There were numbers of candidates who named examples of members of the relevant classes, e.g. 'snake' or 'lizard', for the first response, and 'bat' or 'human' for the third response, but did not name the classes themselves.

Question 2

The completion of the palisade cell diagram identified a number of weaknesses and misunderstandings. There was much evidence that candidates did not read the question carefully and failed to note that they needed to add items to the diagrams as well labelling them. There were many instances of labels that did not point at any added structure. Some candidates did not take note of the existing two labels and relabelled either, or both, of them as entirely different structures. A line drawn inside the cell membrane was often identified as the cell wall, or also labelled as cell membrane. The vacuole of a palisade cell is normally larger than the nucleus.

Responses in (b) were often imprecise. It was expected that candidates would state that these cells were found within leaves and just below the upper epidermis, or just above the spongy mesophyll. Some thought that palisade cells were within other cells, or even that they were cell organelles.

Question 3

Again candidates often failed to read the question carefully, as they were instructed to draw one line from each micronutrient to its deficiency symptom. Some drew two lines from some micronutrients and a large proportion only drew lines from three of the micronutrients. A line from each of calcium and vitamin D should have been linked to the same symptom. There was confusion between the deficiency symptoms of vitamin C and vitamin D.

In (b) a very significant number of candidates suggested that iron was linked to strengthening bones, teeth and even muscles. Few seemed to realise that iron is used to form the haemoglobin found in red blood cells and necessary for the transport of oxygen.

Question 4

A common failing was that candidates failed to state the second product of fat digestion. Other errors in the table were very varied. A significant number of candidates gained the maximum credit.

Many candidates seemed convinced that red blood cells, rather than the plasma, carried glucose. In (b)(ii) candidates should know that the term *breathing* is not synonymous with *respiration*. There was much confusion between starch, stored in plants, but not in humans, and glycogen, stored in the human liver. There was the inevitable confusion between glycogen and glycerol. In (b)(v) the commonest error was to quote insulin and this indicates that the question was not read carefully enough. Both adrenalin and glucagon were acceptable responses.

Question 5

Candidates should have been able to identify stage **D** in (i) and either **A** or **C** in (ii) but there were a number who gave other responses.

In (b)(i) very many candidates appreciated that plenty of food was one factor, but the second factor was often expressed in vague terms, e.g. 'predators', not indicating that there were few predators or none at all. In (ii) there was a tendency not to explain that a factor would be an increase in, or the arrival of, predators. Candidates who gave responses in terms of (b)(i) (birth rate was greater than death rate), or the reverse ((b)(ii)), should appreciate that they were not naming the relevant factors, but rather the overall effects of those factors.

Question 6

Responses throughout this question revealed very limited knowledge and understanding. Throughout this question there were many candidates who used the terms *ovary* and *ovum* as if they were synonymous.

In (a)(i) very few candidates seemed to know that the production and release of oestrogen or progesterone were functions of the ovary. Although the majority of answers referred to the production of reproductive cells, these cells were far too frequently named as 'ovules'. Candidates should be aware that this term is used to describe a structure in the ovary of flowering plants and should not be used to describe the gametes formed in the ovary of female humans. The correct terms are either *ovum* or *egg cell*. Candidates should also be aware that gametes are always single cells and that the ovule is a multicellular structure containing the female gamete. Many candidates stated that a function of the ovary was to act as the site of fertilisation, when this normally occurs in the oviduct. In (ii) the uterus was also frequently believed to be the site of fertilisation. Too many candidates thought that a function of the uterus was to shed its lining (or erroneously, its wall). Although most understood that the functions of the vagina included a site for the deposition of sperm, or to act as the birth canal, a significant number thought that it was the passageway for urine from the bladder.

In (b) very many candidates did not seem to appreciate what was required in the response. Many referred to menstruation but by their answers showed that they did not understand its significance. With regard to menstruation, candidates did not seem to realise that it is only the temporary lining that is shed each cycle, and not the muscular wall or even the whole uterus. The loss of blood is a consequence of the breakdown of the lining containing blood vessels, and *not* the reason for menstruation, as suggested in many responses, e.g. 'the female menstruates to get rid off dirty blood'. Most did not link the cycle to the build up of a new lining in preparation for possible fertilisation and implantation of a new ovum each cycle, or refer to the maintenance of the lining if fertilisation occurred.

Question 7

Part **(a)** again revealed that many candidates did not give their full attention to the instructions in the question. Candidates gave food chains in (i) and examples in (ii) that were not from the food web in Fig. 7.1. Thus they denied themselves full credit in each case. On the whole most candidates drew food chains, but there were some answers that showed pyramids, and there were even a number of 'food circles', which implied that the kestrels were eaten by the oak tree. Although the direction of the energy flow is shown in Fig. 7.1 there were a significant number of candidates who reversed the flow of energy in their food chains. Candidates often failed to make the point that herbivores eat only plant material. In (iii), again, candidates did not read the question carefully and often quoted caterpillars and aphids as the answer when neither of them feeds on an animal.

Many responses failed to make clear predictions about changes in the populations in either example and only offered an "explanation", which often became extremely complex and difficult to follow. Candidates' responses relating to the wren population question were better than those relating to the bank vole population where many thought that, as bank voles did not eat aphids, there would be no effect. Candidates should be aware of the knock on effect that drastic changes in the population of one organism may have on other populations in an ecosystem.

Question 8

Many candidates responded to (a) by giving details of the mechanism of inspiration and / or expiration. Those candidates who did deal with the composition of inspired and expired air often failed to make comparisons. There were many answers that basically stated that inspired air is oxygen and expired air is carbon dioxide. This is incorrect.

Those who responded to this part often listed structures linked to gaseous exchange but did not give details of features that make them more efficient. Many seemed to confuse gaseous exchange with breathing. Those who concentrated their responses on alveoli gained the most credit.

Question 9

A very large percentage of candidates gave clear definitions of osmosis but then seemed in most cases to be unable to apply this to the situations in part **(b)**. Few candidates could offer a single difference between osmosis and diffusion. Many of the answers given were not clear differences and were merely isolated statements about one of the processes. Some of the common misconceptions were, e.g. 'diffusion does not work with a partially permeable membrane' (leaving the reader to guess that the candidate knew that osmosis depends on such a membrane when in fact all diffusion into or out of living cells requires that the diffused materials do pass through such a membrane); 'osmosis occurs down a concentration gradient but diffusion occurs up a concentration gradient' (or vice versa); 'osmosis occurs in plants while diffusion occurs in animals'. Candidates should not use terms such as *strong* and *weak* but should instead use *concentrated* and *dilute*. When using these terms, however, candidates must make it clear whether they are describing the solvent, the water, or the solutes dissolved in the solvent. There was a much greater use of the term *water potential* in this examination than in previous years.

In (b)(i) candidates were expected to relate the root hair cell and the soil water to the liquids referred to in their definitions and to identify the cell membrane as the partially permeable membrane. Responses often detailed the adaptations of the root hair cell and some described the role of the xylem, totally beyond the scope of the question. In (ii), very many candidates recognised that the sea water has a very high concentration of salts and would have a detrimental effect, but very few realised that the normal net movement of water by osmosis would be reversed and that the plants would wilt or die.

Question 10

In this question there were again instances where the candidates did not read the question with sufficient care. The fact that the second generation all had long wings but some of their offspring had short wings indicated that the allele for short wing was present but not showing. Thus, this must be the recessive allele. A significant proportion of candidates, however, identified the recessive allele as long wing. In (ii) many candidates ignored the instruction to use **R** and **r** as their symbols. The symbols they chose were often unsuitable and very rarely explained. Some even used the symbols for the sex chromosomes. Candidates often muddled the phenotype with the genotype. Large numbers of candidates did not appreciate that gametes only carry one allele for any specific gene. In (iii) many attempted to work out the cross and

finished up with a 3 : 1 ratio but then quoted 232 (50% of the offspring) as their response. Others divided 464 by 3 instead of dividing by 4.

In (b) many failed to gain full credit because they omitted the parental phenotypes and genotypes. This was very common when they utilised a Punnett's square as their genetic diagram. Despite these failings, very many did quote the correct ratio, even with no diagram or other working.

BIOLOGY

Paper 0610/31

Extended Theory

General comments

The paper produced a wide range of marks and most questions discriminated well between the candidates. At the top end of the range were some candidates who wrote concise and detailed answers to most of the questions. The Examiners were pleased with the superb quality of these scripts, but there seemed to be fewer of them than in previous sessions. Although most candidates could score enough marks to ensure that there were few very poor scripts, many candidates struggled with the language of the paper, with the demanding concepts of the extended syllabus and with the need to write extended answers. Some made little attempt at any of the answers, often writing disjointed sentences that were not related to the questions. Many of these candidates did not seem to appreciate the idea that the number of points expected in the answer is indicated by the mark allocation. There was also some evidence that these candidates possessed knowledge beyond the syllabus; for example, low scoring candidates identified the elements in proteins in **Question 6 (a)** as guanine, cytosine, adenine and thymine (all spelt correctly). The Examiners felt that these candidates would be more successful (and gain better grades) if they took the short answer paper (Paper 2) and were not given information more suitable to A level.

The candidates found the following questions particularly challenging: **Question 3 (a)(i)** and **(ii)**, **5 (c)** and **5 (e)(i)** and **(ii)**. Questions on the nitrogen cycle are always challenging and **Questions 6 (b)** and **(c)** proved to be no exception. **Question 6 (e)** on population growth did not prompt as wide a range of correct suggestions as anticipated. This was possibly because the context was unfamiliar. Candidates must be prepared to offer suggestions for familiar biological phenomena given in unfamiliar contexts. They should know that their answers must be based on their knowledge and understanding of topics in the syllabus.

Question 3 (c) dealt with limiting factors which is a difficult concept that was handled very well by many candidates. Similarly **Questions 5 (a)**, **(b)** and **(c)** were tackled well by candidates who often found the other questions on the paper quite difficult. Genetics is obviously a topic that candidates find accessible.

Candidates need to have a good understanding of the terminology demanded by the syllabus. The syllabus for examination in 2010 includes definitions of many of the key terms. In **Question 1 (b)** many candidates did not have the required terminology and often failed to use the term *hyphae* from **Question 1 (a)**. The Examiners often came across hyphae described as roots or root hairs. Similarly the term *allele* was used in **Question 5 (b)** but was often not used in answers to **Question 5 (c)** in the explanations of *codominance*. **Question 2 (c)(ii)** asked candidates to describe the health risks of food additives. In response, some candidates stated that food additives 'affect organs of the body'. Sometimes they named organs, such as the liver or kidneys. Similarly, in **Question 3**, candidates stated that light intensity 'affects' the rate of photosynthesis. Candidates should know that no marks are awarded for these statements. They have to be more specific as in the following examples: 'some food additives may cause liver damage' and 'an increase in light intensity causes an increase in the rate of photosynthesis'.

Well prepared candidates appeared to have plenty of time to complete the paper. Blank answers indicated a lack of knowledge rather than insufficient time. Some candidates appeared not to have calculators and did not attempt **Question 3 (b)(i)** and also did not draw the graph. Some knowledge of chemistry is always required in Biology papers. In this paper, it was useful for understanding the feeding mechanism of fungi in **Question 1 (b)**, naming elements in **Question 6 (a)** and writing about the compounds of nitrogen in **6 (b)** and **(c)**. The Examiners saw some excellent descriptions of events in the nitrogen cycle, but many candidates struggled with the concept and could do little more than state that nitrogen compounds in dead bodies are decomposed to nitrogen gas or nitrate, without describing the intervening stages.

The Examiners used a new style of mark scheme for this paper. This report makes reference to the numbers given to marking points and it should be read in conjunction with the mark scheme.

Comments on specific questions

Question 1

(a) Although tables usually give candidates a good chance to answer successfully, few candidates scored full marks for the characteristics of the three groups of microorganisms. It was obvious to the Examiners that many candidates did not know the characteristics of bacteria, viruses and fungi and often gave two ticks in each row. There was no pattern to the mistakes made by candidates although it was usually 'capsule' that those scoring two marks did not know. Candidates often reconsidered their answers to change crosses to ticks or vice versa. In the first case, this leads to hybrid ticks which are always treated as crosses. It is always best to make the final decision clear by putting a line through the first attempt and putting a new tick or cross in the appropriate box.

(b) The Examiners expected candidates to name the hyphae and describe ways in which they are adapted to obtain food. Candidates who wrote that hyphae have a large surface area for the secretion of enzymes for extracellular digestion and absorption of food molecules easily gained three marks. Others confused fungi with plants often referring to hyphae as 'roots' and to photosynthesis. Many did not make it clear that enzymes are secreted or pass out of the fungus into the food and that digestion is *external*. Candidates who stated that enzymes are 'excreted' did not gain this mark. Some candidates gave answers in terms of spore release and spread which were more appropriate to part **(c)**. There were also answers that contained contradictions such as statements about the lack of chlorophyll in fungi which later on in the answer were described as having a large surface area for photosynthesis.

(c) Many candidates referred to the sporangium visible in Fig. 1.1. They stated that it bursts to release spores which are then dispersed by the wind. Some instead referred to the growth of hyphae from one food source to another and this was also accepted. In some answers the sporangium was called a 'capsule'; some candidates took their answer beyond the dispersal of spores describing the germination of spores and the development of hyphae or a mycelium. The terms spore and sporangium were sometimes confused and spores often just fell onto food rather than being dispersed in the air.

Question 2

(a) Some candidates did not attempt this question. However, the majority gave excellent answers. **A** was the structure that gave most problems as it was identified as epidermis, intestine wall, gut wall, villus wall, villi, microvilli, cilia, and goblet cells. The Examiners expected 'epithelium' as an answer, although they did not see it very often. Candidates often did not notice that the question asked them to identify the *region* rather than the cell at the end of the label line. **B** was occasionally identified as 'lymph system', 'lymph node' or simply as 'lymph' instead of lacteal or lymph vessel or lymphatic vessel.

(b) This was usually answered very well with most candidates achieving three or four marks. Most candidates stated that microvilli increase the surface area for absorption, although sometimes this was given as reabsorption, and that mitochondria provide energy for active uptake. Candidates did not receive any credit if they stated that mitochondria *produce* energy; no mark was awarded for the statement that mitochondria are *powerhouses* of the cell. Some thought that these organelles 'store energy'. Some candidates stated that the energy released is for the movement of microvilli and some described the microvilli as 'wafting food in the intestine'. This showed that they were confusing microvilli with cilia.

(c) Most candidates gave two good answers to part **(i)** about the benefits of food additives. Common answers were food preservation and improving the taste or flavour, but often 'improving' was implied in the absolute 'gives flavour' or 'gives taste'. The most common answer that did not gain credit was the statement that additives provide nutrients. This was ruled out by the statement from the Food Standards Agency given at the beginning of the question. In part **(ii)**, the Examiners did not expect candidates to link risks to health with specific food additives although they were pleased to see that many candidates knew that tartrazine and sodium nitrite are linked to hyperactivity in children and cancer respectively. Other risks that were commonly seen were migraines (headaches), asthma, allergies and skin rashes. The Examiners did not accept references to such health problems as heart disease, high blood pressure, high cholesterol, obesity, tooth decay and diabetes that are associated with diets high in saturated fat and sugar. No credit was given to references to improving the taste and hence improving the appetite and causing overeating and

hence obesity. Although most candidates gained at least two marks here, it appeared to the Examiners that this is a part of the extended syllabus that candidates should spend more time exploring. Although this question asked about health risks, it should be pointed out that there are many benefits of using food additives in processed foods and the risks should be balanced against the many benefits to the quality and preservation of our food and also to food security worldwide.

Information about food additives is widely available, for example at:
http://www.nzfsa.govt.nz/consumers/chemicals-nutrients-additives-and-toxins/list-of-food-additives.htm

Question 3

(a) In part **(i)**, many candidates did not understand why the tank of water and the syringe were included in the experimental design shown in Fig. 2.1. The Examiners felt that this indicated that candidates had not considered the design of a suitable experiment to investigate factors affecting photosynthesis in terms of controlling variables and acquiring quantitative data. The tank of water was often thought to be needed to recreate the conditions in the pond or as a reservoir of water. Many thought it was to focus the light on the plant, rather than absorb the heat from the lamp. Many also stated that the syringe was required to add water or replace the water rather than to move the air bubble at the start of each time period. Part **(ii)** also proved to be a good discriminator but few gained marking points 2, 3 or 4 from the mark scheme. The Examiners did not expect candidates at this level to know about photolysis, but wished to credit the statement if given by any candidates. Most candidates stated that oxygen is given off by the plant and then went on to state that this collects in the test tube so increasing the pressure on the water and pushing it down the capillary tube. Some candidates incorrectly stated that the gas is carbon dioxide or air and others that the gas exerted pressure directly on the air bubble in the capillary tube.

(b) Most candidates calculated the rate as 1.4 and entered their answer into the box in Table 3.1. Common errors were 1.6 and 2.1. The graphs for part **(ii)** were usually drawn very well. Neat, precise saltire crosses were used for plotting the points which were joined by straight lines. Sometimes the points were made with much thicker lines which were difficult to see. The Examiners accepted curves drawn freehand if these went through the points or were close to them. They also accepted straight lines of best fit if these were close to the plotted points. In marking the line, the Examiners ignored any extrapolation that candidates may have done to help with their answers to **(c)(i)**. Lines that were extended to the origin were not accepted. A few candidates ignored the tabulated values for the horizontal axis and plotted a straight line of vertical axis values from 0 to 6 using their own incremented horizontal axis values. Others plotted the distance travelled by the bubble rather than the rate.

(c) Most candidates had no problem in predicting the likely rates of photosynthesis for 15 mm and 70 mm. A few predicted rates in excess of 7 mm per minute for 15 mm and a few gave minus figures for 70 mm. The Examiners applied the 'error carried forward' rule here. Part **(ii)** proved to be a good discriminator as only the best candidates were able to explain why the rate of photosynthesis decreased as the lamp was moved further away from the plant. The best candidates referred to light intensity as a limiting factor although some thought that light intensity *increased* with increasing distance of the lamp from the plant because it was read as explain what happens to the rate of photosynthesis on *decreasing* the distance of the lamp so that the answer was the opposite to that required. Imprecise statements such as this did not gain any credit:

'*If there is more light then there is more photosynthesis, if there is less light then there is less photosynthesis.*'

Few candidates stated that light is the source of energy for photosynthesis. Better answers referred to the absorption of light by chlorophyll as part of the explanation.

Question 4

(a) Candidates had two ways to define the term *double circulation* successfully. Some stated that blood passes through the heart twice for one complete circulation of the body. However, some candidates attempting this answer did not make it clear that the blood was making a complete circuit. A good way to do this is to say that on its journey from the lungs and back the blood passes through the heart twice. The second way to answer this question was to name the two circuits:

pulmonary and systemic. The Examiners did not think that statements such as 'there are two sides to the heart' or 'the heart pumps oxygenated and deoxygenated blood' explained the term sufficiently.

(b) Candidates often found it difficult to state functions of the three blood vessels. Some thought that arteries pump blood and some had blood travelling in the incorrect directions in arteries and veins. The statements 'arteries carry oxygenated blood' and 'veins carry deoxygenated blood' were accepted if they were qualified by 'from the heart' and 'to the heart' respectively or by stating that the pulmonary vessels are exceptions. There were fewer reasonable answers for capillary. Common answers that did not gain credit included 'capillaries connect arteries to veins', 'capillaries bring blood close to every cell' and 'allows blood to pass oxygen to the cells' without implying that the blood itself stays in the capillaries. The Examiners gave credit to answers that dealt with the exchange of substances across the capillary wall. Answers that stated this clearly gained the mark easily. Examples were the diffusion of glucose, oxygen and carbon dioxide, gaseous exchange and the movement of water by osmosis.

(c) The Examiners were pleased with the many good, clear answers that related structure to function of the arteries. A significant number thought that arteries pump blood and create pressure and so explained the presence of muscle in this context. Some did not refer to both structure and function. Although marking points 4, 5 and 8 were rarely mentioned, the question gave a good range of marks and was a good discriminator.

(d) Most candidates stated that valves prevent the backflow of blood, but other points proved more difficult. Many candidates stated or implied that the closing of the valves is an active process controlled by muscles and did not emphasise that the actual back flow closes the valves. Some candidates wrote about heart valves rather than valves in the veins.

Question 5

(a) Most candidates identified phenotype and mitosis correctly; chromosome and diploid were commonly chosen for gene and haploid.

(b) For the most part the genetics cross was well answered. Examiners noted that candidates who scored poorly on the paper overall usually did well here. Some candidates ignored the instruction to use the symbols, $\mathbf{I^A}$, $\mathbf{I^B}$ and $\mathbf{I^O}$, instead preferring **A**, **B** and **O**. The Examiners accepted these symbols even when used as well as those given in the question. For example, some candidates found it easier to use the single letters when giving the genotypes of the gametes and using a Punnett square which they often included at the top or bottom of the space for the answer. However, many gave the blood groups as AO and BO rather than A and B and therefore lost a mark. The Examiners applied the *error carried forward* rule in this question. If a candidate made a mistake on one of the lines of the cross, then that line would not gain a mark. However, if the error was continued through the cross then marks were awarded. For example, the genotypes of the parents are $\mathbf{I^BI^O}$ and $\mathbf{I^AI^O}$. If these were given incorrectly, then the remaining three marks could be awarded if the genotypes given were used to derive gametes and offspring genotypes even when this gave phenotypes that were not all different. A common mistake was to give only one allele for the genotypes of the parents and the offspring. This resulted in no marks at all for the question. Another mistake was to give the genotypes as $\mathbf{I^{AO}}$, $\mathbf{I^{BO}}$ and $\mathbf{I^{AB}}$. Some ignored the symbols provided entirely and used **T**/**t** or **X** and **Y**. Answers that used these symbols rarely gained any marks.

(c) The Examiners read many excellent definitions of codominance that made use of blood group AB from part **(b)** as was the intention. There were also many muddled explanations that did not use precise terminology. The term *allele* had been given in the introduction to **(b)** and it was expected that candidates would use this term in explaining codominance. Many wrote about genes; a large number did not make it clear whether they were writing about genes, alleles or blood groups. A difficulty here is that codominance is only evident in the heterozygote – a point made only by the better candidates. Candidates should not state that *blood groups* A and B are dominant. They should not write 'blood groups A and B' when they mean blood group AB. Some candidates referred to other examples of codominance such as roan coat colour in cattle and pink flowers in some species of flowering plant.

(d) The Examiners were pleased to find that this question on insulin production was very accessible. Many candidates discussed the ease of production using genetically modified bacteria in a variety of ways. Most appreciated that bacteria reproduce quickly and can therefore produce the quantities of insulin required especially when demand increases. Very few, if any, explained that this is becoming important as the number of diabetics worldwide increases. In fact, only rarely was the production of insulin linked to the treatment of diabetes in even very good, detailed answers. Not many realised that genetically produced insulin is human insulin Some candidates were not sure about the nature of insulin as they described it as 'dead'. Some did not seem to be aware that it is a protein produced by the action of a gene. Insulin from animals was often described as 'ineffective' when this type of insulin has been used for many years by diabetics and is still available. Some candidates noted that it is possible to modify genetically engineered insulin and this gained credit. However, there were some who thought that the genetically engineered bacteria are injected into a person where they would go on producing insulin. Others compared the reproduction of bacteria with the reproduction of dead tissue, not appreciating how insulin is extracted from dead animals. The need for three points was not noticed by many candidates; some wrote at length, but only made one point, which was usually marking point 7.

(e) Many candidates left **(i)** and **(ii)** blank, suggesting that candidates were unsure about the procedures of genetic engineering. However, there were many correct answers which displayed a detailed knowledge. The term *plasmid* was widely known although many thought that it is made of protein rather than DNA. In part **(ii)**, many gave enzyme or a named enzyme such as restriction endonuclease. The Examiners also accepted 'human gene' or 'insulin gene'.

Question 6

(a) A few candidates left this question blank or gave a variety of compounds rather than elements. For those who knew the elements in proteins this proved to be four easy marks. Almost all correct answers gave the names of the elements as instructed rather than symbols. The Examiners did not award any marks if symbols alone were given, but at least one candidate gave both. Common incorrect answers were: carbohydrate, amino acid, nitrate, sulphate, carbon dioxide, water, phosphorus, magnesium, zinc and potassium.

(b) This question was very poorly answered. Many candidates assumed that root nodules increased the surface area for absorption of nitrate ions or that they acted as stores of these ions. Those who knew that root nodules contain bacteria often incorrectly said that these bacteria were nitrifying bacteria that converted gaseous nitrogen to nitrate ions. Many described the gas as being 'broken down into nitrate' and some confused oxidation with reduction in the chemical process. Others stated that nodules contain nitrogen fixing bacteria (and were awarded two marks), but also thought that these bacteria converted nitrogen to nitrate ions. Candidates should have stated that nitrogen gas is converted to ammonia or ammonium ions or amino acids. The Examiners gave a mark if candidates stated that nitrogen fixed in the nodules is used by legumes to make proteins. They allowed an error carried forward for those who had stated that nitrate is produced in the nodules. The Examiners awarded one mark for stating that nodules contain bacteria.

(c) The Examiners were pleased to read many good, detailed answers to this question about recycling nitrogen. It was clear that these candidates had practised questions from earlier examination papers. Most candidates were able to state that dead plant material is decomposed by bacteria or fungi (for two marks). However, many short-circuited the changes that occur to nitrogen and stated that decomposers release nitrate ions. Some thought that decay occurs spontaneously without any involvement from decomposers. This is an example of a concise answer that easily gains six marking points:

'Dead plants decompose. Bacteria feed on them and deaminate amino acids into ammonia. Nitrifying bacteria change ammonia into nitrate. Nitrate is then absorbed by plants in the root hairs.'

Candidates are often confused about the stages in the nitrogen cycle and which organisms are responsible for these stages. Sometimes candidates write lengthy sentences that do contain correct information about bacteria but also contain incorrect information. Marks were lost by connecting bacteria to the wrong process, often at the end of a lengthy sentence. Nitrifying bacteria and nitrogen fixing bacteria were often described as decomposers. Very few of those candidates who wrote about nitrifying bacteria gave a correct role for them. There was no reason to include nitrogen fixation in the answer to this question.

(d) Most candidates were able to list three factors that limit the growth of a crop. Candidates who gave 'soil', 'pH' or 'oxygen' had to qualify these answers. For example 'soil pH' and 'oxygen in the soil' were acceptable. Some candidates ignored the instruction in the question and gave nutrients or fertilisers, sometimes even naming three nutrients.

(e) The answers to this question on population growth were often too general to gain marks. Many candidates explained that the population of the soya bean aphid does not increase because of unfavourable or unsuitable conditions without stating what these might be. Likewise vague references to unsuitable weather were inadequate without qualification.

References to predators, disease and pesticides were commonly seen and credited. Many also realised that if a population is small to begin with then even doubling its size does not make a large population. Marks were awarded if candidates explained why the population did not increase before day 40 or why it started to increase on that day. Many referred to the growth of the soya bean crop, but failed to explain that this is the aphid's food source. There were also many references to the lag and log phases which were not appropriate. No credit was given for statements such as 'the aphids need time to adjust to their environment'. Comments like this were very common.

BIOLOGY

Paper 0610/32

Extended Theory

General comments

The paper produced a wide range of marks and most questions discriminated well between the candidates. At the top end of the range were some candidates who wrote concise and detailed answers to most of the questions. The Examiners were pleased with the superb quality of these scripts, but there seemed to be fewer of them than in previous sessions. Although most candidates could score enough marks to ensure that there were few very poor scripts, many candidates struggled with the language of the paper, with the demanding concepts of the extended syllabus and with the need to write extended answers. Some made little attempt at any of the answers, often writing disjointed sentences that were not related to the questions. Many of these candidates did not seem to appreciate the idea that the number of points expected in the answer is indicated by the mark allocation. There was also some evidence that these candidates possessed knowledge beyond the syllabus; for example, low scoring candidates identified the elements in proteins in **Question 6 (a)** as guanine, cytosine, adenine and thymine (all spelt correctly). The Examiners felt that these candidates would be more successful (and gain better grades) if they took the short answer paper (Paper 2) and were not given information more suitable to A level.

The candidates found the following questions particularly challenging: **Question 3 (c)** and **(d)**, **5 (c)** and **5 (e)(i)** and **(ii)**. Questions on the nitrogen cycle are always challenging and **Questions 6 (b)** and **(c)** proved to be no exception. **Question 6 (e)** on population growth did not prompt as wide a range of correct suggestions as anticipated. This was possibly because the context was unfamiliar. Candidates must be prepared to offer suggestions for familiar biological phenomena given in unfamiliar contexts. They should know that their answers must be based on their knowledge and understanding of topics in the syllabus.

Question 3 (c) dealt with limiting factors which is a difficult concept that was handled very well by many candidates. Similarly **Questions 5 (a)**, **(b)** and **(c)** were tackled well by candidates who often found the other questions on the paper quite difficult. Genetics is obviously a topic that candidates find accessible. There were some good answers to **Question 4 (d)** on the excretory functions of the liver, which showed good use of information from previous examination papers.

Candidates need to have a good understanding of the terminology demanded by the syllabus. The syllabus for examination in 2010 includes definitions of many of the key terms. In **Question 1 (b)** many candidates did not have the required terminology and often failed to use the term *hyphae* from **Question 1 (a)**. The Examiners often came across hyphae described as roots or root hairs. Similarly the term *allele* was used in **Question 5 (b)** but was often not used in answers to **Question 5 (c)** in the explanations of *codominance*. **Question 2 (c)(ii)** asked candidates to describe the health risks of food additives. In response, some candidates stated that food additives 'affect organs of the body'. Sometimes they named organs, such as the liver or kidneys. Similarly, in **Question 3**, candidates stated that light intensity 'affects' the rate of photosynthesis. Candidates should know that no marks are awarded for these statements. They have to be more specific as in the following examples: 'some food additives may cause liver damage' and 'an increase in light intensity causes an increase in the rate of photosynthesis'.

Well prepared candidates appeared to have plenty of time to complete the paper. Blank answers indicated a lack of knowledge rather than insufficient time. Some candidates did not attempt **Question 3 (b)(i)** and also did not draw the graph. Some knowledge of chemistry is always required in Biology papers. In this paper, it was useful for understanding the feeding mechanism of fungi in **Question 1 (b)**, naming elements in **Question 6 (a)** and writing about the compounds of nitrogen in **6 (b)** and **(c)**. The Examiners saw some excellent descriptions of events in the nitrogen cycle, but many candidates struggled with the concept and could do little more than state that nitrogen compounds in dead bodies are decomposed to nitrogen gas or nitrate, without describing the intervening stages.

The Examiners used a new style of mark scheme for this paper. This report makes reference to the numbers given to marking points and it should be read in conjunction with the mark scheme.

Comments on specific questions

Question 1

(a) Although tables usually give candidates a good chance to answer successfully, few candidates scored full marks for the characteristics of the three groups of microorganisms. It was obvious to the Examiners that many candidates did not know the characteristics of bacteria, viruses and fungi and often gave two ticks in each row. There was no pattern to the mistakes made by candidates although it was usually 'capsule' that those scoring two marks did not know. Candidates often reconsidered their answers to change crosses to ticks or vice versa. In the first case, this leads to hybrid ticks which are always treated as crosses. It is always best to make the final decision clear by putting a line through the first attempt and putting a new tick or cross in the appropriate box.

(b) The Examiners expected candidates to name the hyphae and describe ways in which they are adapted to obtain food. Candidates who wrote that hyphae have a large surface area for the secretion of enzymes for extracellular digestion and absorption of food molecules easily gained three marks. Others confused fungi with plants often referring to hyphae as 'roots' and to photosynthesis. Many did not make it clear that enzymes are secreted or pass out of the fungus into the food and that digestion is *external*. Candidates who stated that enzymes are 'excreted' did not gain this mark. Some candidates gave answers in terms of spore release and spread which were more appropriate to part **(c)**. There were also answers that contained contradictions such as statements about the lack of chlorophyll in fungi which later on in the answer were described as having a large surface area for photosynthesis.

(c) Many candidates referred to the sporangium visible in Fig. 1.1. They stated that it bursts to release spores which are then dispersed by the wind. Some instead referred to the growth of hyphae from one food source to another and this was also accepted. In some answers the sporangium was called a 'capsule'; some candidates took their answer beyond the dispersal of spores describing the germination of spores and the development of hyphae or a mycelium. The terms spore and sporangium were sometimes confused and spores often just fell onto food rather than being dispersed in the air.

Question 2

(a) Some candidates did not attempt this question. However, the majority gave excellent answers. **A** was the structure that gave most problems as it was identified as epidermis, intestine wall, gut wall, villus wall, villi, microvilli, cilia, and goblet cells. The Examiners expected 'epithelium' as an answer, although they did not see it very often. Candidates often did not notice that the question asked them to identify the *region* rather than the cell at the end of the label line. **B** was occasionally identified as 'lymph system', 'lymph node' or simply as 'lymph' instead of lacteal or lymph vessel or lymphatic vessel.

(b) This was usually answered very well with most candidates achieving three or four marks. Most candidates stated that microvilli increase the surface area for absorption, although sometimes this was given as reabsorption, and that mitochondria provide energy for active uptake. Candidates did not receive any credit if they stated that mitochondria *produce* energy; no mark was awarded for the statement that mitochondria are *powerhouses* of the cell. Some thought that these organelles 'store energy'. Some candidates stated that the energy released is for the movement of microvilli and some described the microvilli as 'wafting food in the intestine'. This showed that they were confusing microvilli with cilia.

(c) Most candidates gave two good answers to part **(i)** about the benefits of food additives. Common answers were food preservation and improving the taste or flavour, but often 'improving' was implied in the absolute 'gives flavour' or 'gives taste'. The most common answer that did not gain credit was the statement that additives provide nutrients. This was ruled out by the statement from the Food Standards Agency given at the beginning of the question. In part **(ii)**, the Examiners did not expect candidates to link risks to health with specific food additives although they were pleased to see that many candidates knew that tartrazine and sodium nitrite are linked to hyperactivity in children and cancer respectively. Other risks that were commonly seen were migraines (headaches), asthma, allergies and skin rashes. The Examiners did not accept references to such health problems as heart disease, high blood pressure, high cholesterol, obesity, tooth decay and diabetes that are associated with diets high in saturated fat and sugar. No credit was given to references to improving the taste and hence improving the appetite and causing overeating and

hence obesity. Although most candidates gained at least two marks here, it appeared to the Examiners that this is a part of the extended syllabus that candidates should spend more time exploring. Although this question asked about health risks, it should be pointed out that there are many benefits of using food additives in processed foods and the risks should be balanced against the many benefits to the quality and preservation of our food and also to food security worldwide.

Information about food additives is widely available, for example at:
http://www.nzfsa.govt.nz/consumers/chemicals-nutrients-additives-and-toxins/list-of-food-additives.htm

Question 3

(a) There were some very good answers to this question which proved very accessible to the better candidates. Candidates should have noted that the question referred to 'similar pieces' of plant, so the use of this phrase in a candidate's answer did not gain credit. Candidates who stated that plants of the same species were needed, or of the same size, or with the same number of leaves did gain credit. Many candidates were not sufficiently detailed in their answers giving statements like this one:

'*All other conditions such as the plant and the lamp and the temperature were not changed only the hydrogen carbonate solution'.*

(b) Most candidates gave the correct answer (10) and included it in Table 3.1. Some omitted this question and did not draw the graph in part **(ii)**. Graphs were plotted very well with neat, clear saltire crosses and joined with an appropriate line. Most candidates joined the points carefully with a ruler. Sometimes the points were made with much thicker lines which were difficult to see. The Examiners gave credit to any carefully drawn curves that went through the points or were very close to them. Some candidates lost the mark for plotting points by giving 20.5 instead of 21 for a carbon dioxide concentration of 0.5%. Others lost a mark by drawing a straight line, ignoring the first and last points.

(c) Very few candidates, if any, stated that carbon dioxide is the raw material for photosynthesis. Many also did not note that carbon dioxide concentration is a limiting factor for photosynthesis. In fact, most candidates did not respond to the instruction 'Explain…' instead they simply described the data or gave answers more relevant to **(d)**.

(d) Candidates had to predict the likely rate of photosynthesis at a concentration of 0.6%. Most gave appropriate single numbers; others gave a range, which was also an acceptable answer, so long as the range coincided with that given in the mark scheme. Some candidates noted that carbon dioxide was no longer the limiting factor although others considered that it was still limiting the rate of photosynthesis. Very few referred to the graph in support of their answers. Limiting factors is a difficult concept for candidates to grasp and it proved difficult for many to explain which factors are limiting, and to distinguish these from those that are not limiting.

(e) Better candidates gained the mark easily for this question by giving a source of carbon dioxide, such as respiration within the plant, or the air above. Some candidates stated that photosynthesis could continue because oxygen was available. A small number of candidates explained that the bubbles contained carbon dioxide released from respiration.

Question 4

(a) Most candidates successfully labelled the glomerulus or Bowman's capsule as **P**. Many found it more difficult to label **Q** and **R** successfully. The Examiners only allowed label lines that pointed to the proximal convoluted tubule for **Q** and the collecting duct for **R**. Often label lines ended in the capillaries surrounding the nephron. The Examiners were pleased to see that nearly all candidates followed the rubric and used label lines. Some did not and in this case the Examiners only awarded marks if the letter was written directly over the structure concerned and not to the side in white space around the diagram. Candidates should always follow the rubric in this type of question.

(b) Although the majority of candidates stated that water is reabsorbed in the kidney by osmosis many did not refer to the movement of water down a water potential gradient. Considerable confusion existed over the direction of water potential gradients. Some described reabsorption in the wrong direction – from the blood to the filtrate. Some candidates referred to anti-diuretic hormone (ADH) but few described its effect on the permeability of the collecting ducts to water. There were some incorrect references to the reabsorption of water by active uptake.

(c) Most candidates described the pathway taken by urine with most stating that it is stored in the bladder. In all but a few cases ureter and urethra were spelt correctly. However, there were some candidates who seemed to find it hard to visualise the pathway taken by urine without a diagram.

(d) There were many detailed descriptions of the functions of the liver in excretion. Most candidates obtained their marks with references to the deamination of excess amino acids and the production of urea. The Examiners also saw answers giving the breakdown of red blood cells, the production of bile and the breakdown of toxins as functions. Some candidates named substances such as drugs, hormones and alcohol, for which there were two marks available. Candidates who merely stated that the liver 'deals with' toxins or these named substances did not gain marks. It was surprising that the breakdown of hydrogen peroxide by catalase was not mentioned very often since this is a common topic for experimental work at this level.

Question 5

(a) Most candidates identified phenotype and mitosis correctly; chromosome and diploid were commonly chosen for gene and haploid.

(b) For the most part the genetics cross was well answered. Examiners noted that candidates who scored poorly on the paper overall usually did well here. Some candidates ignored the instruction to use the symbols, $\mathbf{I^A}$, $\mathbf{I^B}$ and $\mathbf{I^O}$, instead preferring **A**, **B** and **O**. The Examiners accepted these symbols even when used as well as those given in the question. For example, some candidates found it easier to use the single letters when giving the genotypes of the gametes and using a Punnett square which they often included at the top or bottom of the space for the answer. However, many gave the blood groups as AO and BO rather than A and B and therefore lost a mark. The Examiners applied the *error carried forward* rule in this question. If a candidate made a mistake on one of the lines of the cross, then that line would not gain a mark. However, if the error was continued through the cross then marks were awarded. For example, the genotypes of the parents are $\mathbf{I^BI^O}$ and $\mathbf{I^AI^O}$. If these were given incorrectly, then the remaining three marks could be awarded if the genotypes given were used to derive gametes and offspring genotypes even when this gave phenotypes that were not all different. A common mistake was to give only one allele for the genotypes of the parents and the offspring. This resulted in no marks at all for the question. Another mistake was to give the genotypes as $\mathbf{I^{AO}}$, $\mathbf{I^{BO}}$ and $\mathbf{I^{AB}}$. Some ignored the symbols provided entirely and used **T**/**t** or **X** and **Y**. Answers that used these symbols rarely gained any marks.

(c) The Examiners read many excellent definitions of codominance that made use of blood group AB from part **(b)** as was the intention. There were also many muddled explanations that did not use precise terminology. The term *allele* had been given in the introduction to **(b)** and it was expected that candidates would use this term in explaining codominance. Many wrote about genes; a large number did not make it clear whether they were writing about genes, alleles or blood groups. A difficulty here is that codominance is only evident in the heterozygote – a point made only by the better candidates. Candidates should not state that *blood groups* A and B are dominant. They should not write 'blood groups A and B' when they mean blood group AB. Some candidates referred to other examples of codominance such as roan coat colour in cattle and pink flowers in some species of flowering plant.

(d) The Examiners were pleased to find that this question on insulin production was very accessible. Many candidates discussed the ease of production using genetically modified bacteria in a variety of ways. Most appreciated that bacteria reproduce quickly and can therefore produce the quantities of insulin required especially when demand increases. Very few, if any, explained that this is becoming important as the number of diabetics worldwide increases. In fact, only rarely was the production of insulin linked to the treatment of diabetes in even very good, detailed answers. Not many realised that genetically produced insulin is human insulin Some candidates were not sure about the nature of insulin as they described it as 'dead'. Some did not seem to be aware that it is a protein produced by the action of a gene. Insulin from animals was often described as

'ineffective' when this type of insulin has been used for many years by diabetics and is still available. Some candidates noted that it is possible to modify genetically engineered insulin and this gained credit. However, there were some who thought that the genetically engineered bacteria are injected into a person where they would go on producing insulin. Others compared the reproduction of bacteria with the reproduction of dead tissue, not appreciating how insulin is extracted from dead animals. The need for three points was not noticed by many candidates; some wrote at length, but only made one point, which was usually marking point 7.

(e) Many candidates left **(i)** and **(ii)** blank, suggesting that candidates were unsure about the procedures of genetic engineering. However, there were many correct answers which displayed a detailed knowledge. The term *plasmid* was widely known although many thought that it is made of protein rather than DNA. In part **(ii)**, many gave enzyme or a named enzyme such as restriction endonuclease. The Examiners thought the diagram a little ambiguous at this point so also accepted 'human gene' or 'insulin gene'.

Question 6

(a) A few candidates left this question blank or gave a variety of compounds rather than elements. For those who knew the elements in proteins this proved to be four easy marks. Almost all correct answers gave the names of the elements as instructed rather than symbols. The Examiners did not award any marks if symbols alone were given, but at least one candidate gave both. Common incorrect answers were: carbohydrate, amino acid, nitrate, sulphate, carbon dioxide, water, phosphorus, magnesium, zinc and potassium.

(b) This question was very poorly answered. Many candidates assumed that root nodules increased the surface area for absorption of nitrate ions or that they acted as stores of these ions. Those who knew that root nodules contain bacteria often incorrectly said that these bacteria were nitrifying bacteria that converted gaseous nitrogen to nitrate ions. Many described the gas as being 'broken down into nitrate' and some confused oxidation with reduction in the chemical process. Others stated that nodules contain nitrogen fixing bacteria (and were awarded two marks), but also thought that these bacteria converted nitrogen to nitrate ions. Candidates should have stated that nitrogen gas is converted to ammonia or ammonium ions or amino acids. The Examiners gave a mark if candidates stated that nitrogen fixed in the modules is used by legumes to make proteins. They allowed an error carried forward for those who had stated that nitrate is produced in the nodules. The Examiners awarded one mark for stating that nodules contain bacteria.

(c) The Examiners were pleased to read many good, detailed answers to this question about recycling nitrogen. It was clear that these candidates had practised questions from earlier examination papers. Most candidates were able to state that dead plant material is decomposed by bacteria or fungi (for two marks). However, many short-circuited the changes that occur to nitrogen and stated that decomposers release nitrate ions. Some thought that decay occurs spontaneously without any involvement from decomposers. This is an example of a concise answer that easily gains six marking points:

'Dead plants decompose. Bacteria feed on them and deaminate amino acids into ammonia. Nitrifying bacteria change ammonia into nitrate. Nitrate is then absorbed by plants in the root hairs.'

Candidates are often confused about the stages in the nitrogen cycle and which organisms are responsible for these stages. Sometimes candidates write lengthy sentences that contain correct information about bacteria but also incorrect information. Marks were lost by connecting bacteria to the wrong process often at the end of a lengthy sentence. Nitrifying bacteria and nitrogen fixing bacteria were often described as decomposers. Very few of those candidates who wrote about nitrifying bacteria gave a correct role for them. There was no reason to include nitrogen fixation in the answer to this question.

(d) Most candidates were able to list three factors that limit the growth of a crop. Candidates who gave 'soil', 'pH' or 'oxygen' had to qualify these answers. For example 'soil pH' and 'oxygen in the soil' were acceptable. Some candidates ignored the instruction in the question and gave nutrients or fertilisers, sometimes even naming three nutrients.

(e) The answers to this question on population growth were often too general to gain marks. Many candidates explained that the population of the soya bean aphid does not increase because of unfavourable conditions without stating what these might be. Likewise vague references to unsuitable weather were inadequate without qualification.

References to predators, disease and pesticides were commonly seen and credited. Many candidates also realised that if a population is small to begin with then even doubling its size does not make a large population. Marks were awarded if candidates explained why the population did not increase before day 40 or why it started to increase on that day. Many referred to the growth of the soya bean crop, but failed to explain that this is the aphid's food source. There were also many references to the lag and log phases which were not appropriate. No credit was given for statements such as 'the aphids need time to adjust to their environment'. Comments like this were very common.

BIOLOGY

Paper 0610/04

Coursework

General comments

Centres continue to produce a wide range of interesting and challenging tasks in which their candidates can develop and demonstrate their practical skills. The majority of Centres are now settled with a particular group of experiments or investigations, although most do like to introduce something new from time to time, or make changes to a tried and tested task.

The best tasks for assessment are ones that have a clear focus and that generate quantitative results. These tend to involve enzymes, transpiration, osmosis, photosynthesis, homeostasis (temperature regulation), heart or breathing rate or ecology. Skill 2 is sometimes assessed through the collection of data related to variation, such as leaf length. Centres now fully appreciate that the tasks must involve the candidates in performing genuine practical work (rather than purely pencil-and-paper exercises) and that they must be sufficiently open-ended to allow candidates to make some decisions, if it is intended to make the whole range of marks accessible.

There are still occasional instances of Centres failing to supply evidence for their C1 assessments. This does need attention, as the skills assessed are ephemeral, and there is nothing written by candidates that the Moderators can see. The external Moderators therefore depend on records kept and submitted by the teacher, such as tick lists or summaries of each candidate's performance on a particular task, in relation to the mark scheme.

Another issue that sometimes arises is the lack of task-specific mark schemes. The syllabus provides generic criteria for each level of each skill, but it is the teacher's task to use these generic criteria to construct a set that relates directly to the particular task being assessed. This enables the teacher or teachers to look for particular points in a candidate's work that indicate that a particular level has been reached. The external Moderators pay considerable attention to these task-specific schemes, and it is important that care is taken in their construction.

It is always pleasing to see some excellent work submitted as part of the coursework samples from many Centres. This Paper allows candidates to demonstrate their practical skills to the highest level, and it is especially pleasing to see the most demanding of these skills – planning and evaluation – handled with confidence by numerous candidates.

Many Centres make good use of IT in their coursework assessments, for example in producing worksheets and mark schemes and in keeping records. Candidates sometimes word process their work, and in some Centres this is also marked on a computer. (If this is done, it is very important that the teacher's comments are in a different font, so that it is easy to pick these out when the document is printed.) It is most important, however, that the work presented is entirely genuine and entirely the candidate's own, unaided work. Teachers must be able to guarantee that this is so. This may mean that it is better to use a candidate's original, hand-written work generated as the task was being carried out, rather than neatly rewritten work submitted several days afterwards. The external Moderators are more interested in the content of the work than its overall neatness and presentation.

BIOLOGY

Paper 0610/05

Practical Test

General comments

The general standard of work was similar to that seen in previous sessions. The general comments are also similar to those made in previous sessions as the same points need to be made and acted upon if candidates' performance is to improve. It is clear that advice given year on year in previous Examiner's Reports has not been followed by a minority of Centres, although some Centres clearly follow the advice and their candidates are well-prepared and perform well.

Only a small number of Centres did not submit a Supervisor's Report or seating plan on this occasion, showing a continual improvement on 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 observe and do, even if the material had looked or behaved in an unexpected way. On this occasion, for **Question 1(a)**, Centres were asked to provide a set of results that indicated which pH was more active. This allowed Examiners to credit a candidate's recording of a lack of bubbles at a particular pH if this was in line with the results obtained by the Centre. Identification and/or drawing of specimens supplied to the candidates is always a good idea. On this occasion, this was required for **Question 2**. 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. 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 being part of 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.

There is an increasing tendency for candidates to use ballpoint pen or very thick pencil to draw diagrams and graphs. Centres should advise their candidates to use a well-sharpened pencil (preferably 2B) for diagrams and graphs. The lines and points should then be clear and unambiguous and any errors can be easily erased.

Comments on specific questions

Question 1

(a) (i) Most candidates were able to construct a suitable table in which to record their results. A common error was to fail to provide suitable column or row headings. Tables were expected to be neatly ruled.

(ii)(iii) Most candidates recorded results for each of the pH values. Some candidates supplied results for pH 6, which was not one of the solutions that should have been supplied. Some candidates unexpectedly recorded the results for some of the test tubes as 0 bubbles. Unless this was supported by the results given in the Supervisor's Report, it was assumed that the procedure had not been followed correctly (as all test tubes were expected to have produced sufficient reaction to produce bubbles in the specified time) and therefore these results were not credited. If the results submitted by the Centre had included a reading of 0 bubbles for that particular pH, then a reading of 0 bubbles would be credited.

(b) (i) It was rare to award full marks for the graph. The axes should be orientated and labelled correctly, together with units. Units were frequently missing. The axes should also be scaled in even increments (i.e. pH3, pH4, pH5, pH6, pH7, etc. on the x axis; e.g. 5, 10, 15, 20, etc. on the y axis). A common error was to omit pH 6 from the scale on the x axis. Some errors were seen in plotting the results. Candidates should be encouraged to choose scales that make plotting the points easy as they may experience problems deciding upon the location of the points if the scale is inappropriate.

(ii) Candidates were expected to describe the relationship that was demonstrated by their own results. Marks were only awarded if the relationship was described accurately. It should be noted that a peak can only be described if it is an increase followed by a decrease. It is not accurate to describe the highest value as a peak if it is at either end of the series of results. Candidates were expected to use the term 'optimum' to describe the pH in which the enzyme worked most vigorously.

(c) Some good answers were seen to this part of the question but a significant number of candidates included details that had already been covered in the procedure, such as counting the number of bubbles produced for the same length of time in each case. Others made suggestions relating to extensions to the investigation, which was not answering the question. There were deficiencies in the method that candidates were expected to have identified, such as controlling the temperature, standardising the cutting of the potato cubes to provide equal surface area, measuring the volume of gas evolved rather than counting bubbles and including intermediate pH values.

(d) This part of the question proved to be a great challenge to many candidates. It was rare to award full marks. The question had asked for ways in which the experiment could have been changed but candidates tended to deal very superficially with the changes and concentrated much of their answers on repeating details of the original procedure. Candidates have experienced problems with questions that require them to suggest experimental procedure or modification of an existing procedure in the past.

Question 2

(a) This question was answered reasonably well. Many diagrams, however, did not have clear unbroken lines as many of them were sketched with gaps or shading. Label lines for structures are expected to touch the relevant structure, particularly when a number of structures are close together.

(b) Some candidates appeared to have cut the specimen in the wrong plane, vertically rather than horizontally. Sketched lines were also evident here and some diagrams were rather small. Labelling was poor, with many candidates failing to label anything appropriate, e.g. the developing seeds.

(c) This part of the question was poorly answered, with a significant proportion failing to attempt it. Some candidates simply labelled the structures while others covered the space with prose. Candidates were expected to label structures clearly and to annotate to indicate the adaptation of that part of the flower.

(d) (i) Most candidates were able to supply a relevant similarity that related to pollination.

(ii) There were mixed responses to this question. Candidates were expected to provide a comparative statement relating to the same aspect on the same line. So a mark would be awarded for stating that W1 produced few pollen grains and on the same line stating that W2 produced a large number of pollen grains. If, however, the statement for W1 that it produced few pollen grains was paired with W2 having an anther that was hanging outside the flower, then a mark would not be awarded. This is because, even though both statements were correct, the difference was not clearly stated. Candidates were also expected to cover a range of structures and features rather than just concentrating on one structure. A further error was to repeat the same difference but expressing it in different ways.

BIOLOGY

Paper 0610/06
Alternative to Practical

General comments

The standard of English was generally good and the presentation of answers showed good understanding of the questions. Some candidates had difficulty with the language required, for example, for planning (**Questions 1(b)** and **3(c)**). Candidates' diagrams were sometimes well presented, but some diagrams were unlabelled. Candidates need to use clear outlines and an HB pencil. Many candidates presented accurate line graphs in **3(a)(ii).**

There were examples in all questions of candidates failing to read the question carefully and therefore losing marks.

Overall, the paper produced a wide range of marks, many in the over 30-mark range. Candidates attempted all questions and most showed that they had adequate time to finish the paper.

Comments on specific questions

Section A

Question 1

This question was based on the movement of water into and out of pieces of dandelion stem by osmosis. As the stems were cut as shown in Fig. 1.1 the tissue curved when placed in various solutions. Some of dandelion pieces were placed in a concentrated salt solution (0.8 mol dm^{-3}) and others in distilled water (0.0 mol dm^{-3} salt solution). The outer layer of the stems, referred to as the epidermis, has a cuticle making it impermeable to water; this is the reason why the pieces curved in the manner illustrated in Fig. 1.1.

(a) (i) This question asked for a description of the appearance of two pieces of dandelion stem that had been placed in one of the two solutions, as shown in Fig. 1.1. Able candidates described the distortion of the stems in various ways to indicate that the piece of stem in the 0.8M salt solution had curved with the inner tissue on the inside of the curve, and that the piece of stem in the 0.0M salt solution (distilled water) had curved with the inner tissues exposed and on the outside of the curve. Both pieces changed shape; neither remained unchanged. Many incorrect answers included the idea that the stem increased in length or size. Some candidates gave an explanation instead of a description, covering the points asked for in the next question.

(ii) The causes of the change in curvature of the pieces of dandelion stem were generally well known and explanations included details of osmosis including: the movement of water, direction, gradient and the effect of osmosis on tissues that would result in the changes in curvature. Few candidates mentioned that the outer layer was impermeable to water.

Osmosis is clearly defined in the syllabus as the diffusion of water molecules from a region of their higher concentration (however that is expressed, including 'high water potential') to a region of their lower concentration, through a partially permeable membrane (again, various alternative terms are used in different textbooks).

Some of the candidates lost marks when they stated that one of the stems had not changed.

Other candidates incorrectly thought that the salt solution moved into or out of the stem; some candidates incorrectly thought that the salt entered and dried up the stem.

(b) Planning an investigation to find the concentration of salt solution which would produce no change in the curvature of the pieces of dandelion stem gave candidates an opportunity to express their practical organisation skills. All variables need to be controlled except for the concentration of salt solutions. In other words, a range of salt concentrations between the two mentioned in the question (0.8 mol dm^{-3} and 0.0 mol dm^{-3}) is needed but the size of the pieces of dandelion used for each concentration and the timing of the immersion of each piece in solution needs to be the same. It would also be necessary to include a number of repeats, either of the whole investigation by the same candidate or different candidates, or by using several pieces of dandelion stem in each of the different salt solutions. The results need to be analysed to enable the plotting of a graph to identify the concentration where no change occurs to the curvature. There were some excellent accounts seen where all of these points were covered in detail. Some candidates preferred to investigate how mass of tissue affected the outcome and changed the size of the plant tissue used. These plans were considered in the light of the control of variables and the range of salt solution concentrations.

Weaker candidates described the original plan with two salt solutions; others referred to the input of data but failed to include any specific details. Quite a few candidates described experiments involving the removal of cell sap, measuring its concentration and then putting the stem into a solution of this concentration to see no change in curvature. A number assumed that the dandelion stem would not change shape in water. Some weak candidates described an experiment involving the evaporation of the salt from the solution.

It was clear that some candidates were not able to plan an investigation to make valid comparisons enabling the drawing of conclusions and require further practice in these skills. A plan needs to contain sufficient detail so that another experimenter might follow the steps to carry out the same investigation.

Question 2

(a) Overall the standard of drawing was good with the majority of candidates making an obvious attempt to copy from the photograph in Fig. 2.1. There were a few stylised drawings seen where the drawing of the flower did not resemble the photograph. Less shading and clear outlines with fewer sketchy lines are expected in a biological drawing.

Most candidates were able to gain at least two label marks for petal, sepal or stigma. Most drawings showed three stamens, although there were a significant number of drawings showing either two or four stamens. A common error was confusing the structures, and labelling a stamen or anther as the stigma. The style label mark was often not awarded as most label lines indicated too far down in the ovary. More precision with the location of label lines is advised.

(b) This question was based on a wind-pollinated flower and as some candidates were not familiar with the structures of a grass flower, the instruction to label the floral parts was included to facilitate interpretation of candidate answers. The visible features were required rather than invisible details of pollen grains.

Many candidates were able to gain marks here for describing the feathery stigma and anther hanging outside the bracts with a long, flexible filament. Unfortunately, there was again confusion over the naming of stamens or anthers, with many candidates confusing them with the stigma and style.

(c) (i) Most candidates did describe one common feature of the flowers shown in Fig. 2.1 and Fig. 2.2, for example, the presence of anthers or stigmas, but the named adaptations given by some candidates were not linked to pollination, for example, the ovary/carpel. Some candidates did mention stigmas but then lost the mark by wrongly saying that **both** stigmas were feathery or both were outside the flower. Another common error was made when referring to pollen production, which was not shown in the two figures.

(ii) We expected candidates to give four observable differences between the two flowers shown in Fig. 2.1 and Fig. 2.2 in order to complete Table 2.1; differences that you can see between the illustrations. One difference was expected in each row; with a statement for one flower matching the opposite statement for the other flower. Many of the able candidates did complete the table in this way and gave at least three differences based on a description of the stigma and its position and a relevant difference for the stamen or anther. Few candidates gained a mark relating to

petals versus no petals, and some candidates referred incorrectly to the bracts of the grass flower shown in Fig. 2.2 as small petals. Many candidates gave learned responses linked to adaptations for pollination, e.g. referring to scent, nectar, colour of petals and the size or amount of pollen, instead of visible differences. Less able candidates often failed to give matched features in each row of the table and described parts of the flower and features at random.

Question 3

(a) (i) Data for the experiment was given in Table 3.1 and the question specified a line graph. Few graphs other than line graphs were seen. Although most candidates correctly orientated the axes, with the time taken for the filter paper to rise in seconds on the y-axis and pH on the x-axis, there were a significant number of candidates who reversed the orientation. It would useful to advise candidates that what is being measured in a set of results (the dependent variable) should be plotted on the y-axis (vertical axis). Additionally, the leftmost column in a results table should give the variable that is under the control of the experimenter, such as pH or temperature (the independent variable). Some candidates incorrectly recorded pH – it would be helpful to explain what this term stands for in relation to the number of H^+ ions.

Candidates were required to take more than half of the available grid to draw their graphs. A suitable scale for time, chosen by many candidates, equated one small square to one second and started from zero. Time needed to be placed on the vertical axis. The selection of a scale to represent pH caused problems for some candidates when they chose to start the pH scale from zero. As the first reading in the table is pH 3, there is no need to start the pH scale below this value. The seven 2 cm divisions available horizontally would then allow the candidate to reach pH 8 with ten small squares equal to a pH difference of one. The plotting of the data was accurate and only a few errors were seen. The line joining the points was usually ruled point to point, with few free hand lines noted. There were few lines of best fit or extrapolations of the line.

(ii) A clear description of what happened at the different stages of the graph between pH 3-7 and then between pH 7-8 was required. Able candidates described these two phases well. Candidates who gave general descriptions, for example, 'the higher the pH, the less the time taken, except pH 8', did not describe what happens with sufficient detail. Another other point of confusion for less able candidates was to recognise that the shorter time indicated the faster reaction. Many candidates recorded the optimum value at pH 7.

(b) Many candidates were able to list four improvements to the experiment described in the question. Instead of timing the rise of a piece of filter paper in a tube, many suggested the collection of oxygen over a specific timed interval, using a gas syringe to record the volume produced. Other improvements included: safety factors, improving the control of pH with buffers, and using intermediate values between pH 3 and pH 8. The original data showed that the enzyme activity was slowing at the two extremes of pH given, so there was no reason to increase the pH range to 14 as many candidates suggested. The use of measuring meters or stop clocks to record the activity was mentioned by some candidates, as well as the possibility of controlling the volume and concentration of the reagents. Keeping the volume and shape of the test tubes constant by using the same apparatus was also mentioned. The most frequent idea presented was that of repeating the procedure to increase reliability. This was often the only mark for the less able candidates.

(c) This question again gave an opportunity for candidates to use their planning skills. They were asked to outline an investigation on the effect of temperature on catalyse activity. By using a range of different temperatures and controlling the pH, the volume, and the concentrations of enzyme and substrate, candidates gained many marks. If the plan described how the temperature was to be maintained with the use of a water bath and also mentioned allowing the reagents to come to temperature separately (equilibrating) prior to mixing then full marks were gained. Safety factors and repeating the procedure were also considered by many candidates. Less able candidates lost marks by referring to only two temperatures, or by giving only vague descriptions of how to heat tubes, using a thermometer in a way that would not enable them to find the effects of different temperatures. A small number of candidates did not answer this question possibly because they did not know how to plan this investigation or had not managed their time effectively.