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BIOLOGY

Paper 0610/11
Multiple Choice

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

General Comments

The test spread the candidates extremely successfully across the mark range. At the lower end of ability, a larger number of candidates scored less than the total that might have been obtained using the 'guessing method'. This suggests that several of the questions examined areas where there are traditional misconceptions.

Comments on Specific Questions

Question 1

This was one of the easiest questions on the paper, but that does not detract from the fact that an important topic on the syllabus was thoroughly understood by a very high percentage of the candidates.

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Question 3

It is possible that candidates struggled more to recall what an annelid was than to follow a dichotomous key. The evidence for this is that 12 % believed them to have legs, and a further 25 % thought that they have a shell.

Question 7

This question highlighted the need for more careful thought before answering. Candidates realised that the covering to a villus is single-celled, and thus were attracted by the first option that the wall is a cell. Consideration of the later options might have allowed them to realize that a wall made up of a single layer containing many cells in a row, is a tissue.

Question 12

As with **Question 7**, above, candidates were, quickly attracted to jump to the fact that starch is broken down by amylase, but it is option **D,** aided by the diagram, that should have reminded them that it is to the disaccharide, maltose, and not to the monosaccharide, glucose.

Question 20

This proved to be this most demanding question on the paper, and prompted a degree of guess-work. This appeared to reveal two areas of confusion in almost two-thirds of the candidates. First, they were not clear exactly what *is* carried in the blood, and second, collectively they believed that either cellulose, starch or glycogen are soluble. Significantly, it was only the more able candidates that successfully assimilated the information to reach the correct answer.

Question 33

This was a low demand question, and most found no difficulty. It was only the least able candidates who lacked the required knowledge.

Question 38

Mathematical terms do not feature prominently in the syllabus, but 'exponential' and 'log' are two that are required in the context of the sigmoid population growth curve. A few of the more able candidates were distracted by **A**. This shows some uncertainty in the phases of the population growth curve.

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BIOLOGY

Paper 0610/12
Multiple Choice

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

General Comments

The test spread the candidates extremely successfully across the mark range. At the lower end of ability, a larger number of candidates scored less than the total that might have been obtained using the 'guessing method'. This suggests that several of the questions examined areas where there are traditional misconceptions.

Comments on Specific Questions

Question 1

The need to think carefully before answering was illustrated by this question. Almost a third of the candidates suggested that a root hair cell has chloroplasts. Some of these candidates would, having given the question a little more time, have come to the correct conclusion.

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Question 6

This was one of the easiest questions on the paper, but that does not detract from the fact that an important topic on the syllabus was thoroughly understood by a very high percentage of the candidates.

Question 9

It was revealing that over a quarter of the candidates confused the names for the canine and incisor teeth. This is a simple recall question and the results highlight a possible area for improved teaching.

Question 12

The comment made with reference to **Question 9** also applies here, as well over a quarter of candidates were uncertain of the correct sequence of the parts of the alimentary canal.

Question 25

This proved to be this most demanding question on the paper, and prompted a degree of guess-work. This appeared to reveal two areas of confusion in almost two-thirds of the candidates. First, they were not clear exactly what *is* carried in the blood, and second, collectively they believed that either cellulose, starch or glycogen are soluble. Significantly, it was only the more able candidates that successfully assimilated the information to reach the correct answer.

Question 30

A third of candidates opted incorrectly for **C**. This suggests that a large proportion of candidates did not fully understand where mitosis occurs but they could recognise an example of development.

Question 37

It is essential in questions where information is provided in tables or graphs to read the data carefully and decide exactly what facts are being supplied. A third of the candidates opted incorrectly for **C**. More careful thought was needed to realise that it was the pesticide that was in the lowest concentration which was the most dangerous.

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BIOLOGY

Paper 0610/13
Multiple Choice

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

General Comments

The test spread the candidates extremely successfully across the mark range. At the lower end of ability, a larger number of candidates scored less than the total that might have been obtained using the 'guessing method'. This suggests that several of the questions examined areas where there are traditional misconceptions. Generally, however, candidates performed very well on a paper covering the traditional wide range of topics with only two questions being correctly answered by less than half of the candidates (and even those attracted 47 % correct responses).

Comments on Specific Questions

Question 3

This was one of the easiest questions on the paper, but that does not detract from the fact that an important topic on the syllabus was thoroughly understood by a very high percentage of the candidates.

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Question 5

This question was answered correctly by the vast majority of the more able candidates. It was encouraging that only a small number of candidates thought that the nucleus should be found within the cell wall.

Question 25

This was another well answered question, but it served to show that candidates are aware that water exits a leaf having already evaporated. This is to their credit as it is otherwise quite common, when asked to describe the process, for candidates to imply that evaporation does not occur until water is on the leaf surface.

Question 29

A third of candidates opted incorrectly for **C**. This suggests that a large proportion of candidates did not fully understand where mitosis occurs but they could recognise an example of development.

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BIOLOGY

Paper 0610/21
Core Theory

Key Messages

Success on this paper requires candidates to use the correct biological terms as much as possible. They also need to read all parts of a question with great care to ensure that they do not misunderstand what is required.

General Comments

There was little evidence to suggest that candidates did not have sufficient time to complete the paper. **Question 7** and parts of **Question 3** were poorly answered or left blank by many candidates, but this appeared to be due to lack of familiarity with the topics. Most candidates showed reasonable understanding of the topics examined but responses were often too vague to gain full credit. There was some evidence of careless reading of the questions (**Question 3(b)**, **5(a)(i)** and **6(a)**) and candidates did not always appear to utilise the mark allocation indicated on each question when planning their responses. Candidates should be encouraged to use correct biological terminology in their responses to ensure it is correctly understood by Examiners.

The legibility of some scripts was a cause for considerable concern to Examiners. Credit cannot be given if very poor writing or alterations mean that the candidate's response cannot be determined. Candidates had difficulty in applying general principles and understanding to unfamiliar situations, such as **Question 10(b)(iii)**.

Comments on Specific Questions

Question 1

The majority of candidates correctly identified the crab as a crustacean. The commonest error was to tick the myriapod box. The use of the key seemed to present little difficulty to the majority of candidates and most gained full credit. Some candidates attributed the same name to two different crabs although the five crabs are clearly different species.

Question 2

(a) Most candidates understood the role of valves but there was a significant minority whose responses suggested that they thought the valves had some sort of pushing function to keep blood flowing. Most candidates followed the instruction to tick two responses and usually identified veins as one of the responses. Only about half of the candidates correctly identified a second structure.

(b) Many candidates clearly used their practical knowledge of counting the pulse rate while others listened to the heartbeat but not all chose a suitable period of time for making the measurement. Some suggested time spans such as 1 second or up to half an hour, both of which were considered unrealistic. Many candidates realised that the thumb should not be used to take a pulse. There were a few who suggested that a thermometer or a heart lung machine would be suitable devices to use for this measurement.

(c)

(i)(ii) Extracting the correct data presented candidates with very few problems.

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(iii) Many did not appreciate that a "trend" should not refer to individuals but to the whole group. A significant number realised that heart rate rose as a result of exercise and that the males tended to have higher heart rates than the females.

(d) The majority of candidates appreciated that extra oxygen is needed during exercise and this was often linked to muscle activity. However, few realised that exercise needs extra energy and that this is released by respiration. The rise in heart rate was needed to deal with the consequences of these events. A minority of candidates think that during exercise anaerobic respiration replaces rather than supplements aerobic respiration and others related all the changes to the effects of adrenalin.

Question 3

(a) A significant majority appeared to be totally unfamiliar with geotropism. Candidates should be aware that tropisms are growth responses to directional stimuli. In the case of geotropism the stimulus is gravity and not light. Candidates should also realise that different parts of plants respond in different ways to such stimuli. Only a very small number of candidates realised that the stimulus caused roots to grow downwards in the soil and thus were more likely to gain water, minerals and improved anchorage.

(b) Candidates rarely identified water, oxygen and a suitable temperature to gain full credit. Very few types of seeds need light for the process of germination and possibly candidates who gave this as a response were thinking of conditions needed for the seedling after germination.

Question 4

(a)

(i) Candidates seemed familiar with the water cycle and many of them gained full credit.

(ii) It was disappointing that many who identified process **C** as condensation could not continue this line of thought to explain why this led to rainfall over hills and mountains. Many responses suggested either that some sort of squeezing effect occurred as clouds bumped into the mountains or that contact with the ground caused rainfall.

(b) Most candidates used the information on the diagram to explain how nutrients arrived in the lake.

(c) It was clear that candidates understood the effects of deforestation on the water cycle but their responses were not always well explained.

Question 5

(a) Few candidates had any difficulty in gaining full credit in **(ii)** and **(iii)**. It was disappointing that few candidates identified the process of photosynthesis in **(i)** and respiration occurred more frequently as a response.

(b) Many candidates suggested that an endangered species was already extinct rather than it was a species that had a high risk of becoming extinct.

(c) The vast majority realised that killer whales and polar bears competed for the same food sources and correctly described the consequences of the loss of the polar bears. There was a small number who misread the food web and suggested that with the loss of the polar bears the killer whales would lose it from their food supply and their numbers would decrease or they would even become endangered.

Question 6

(a)

(i) There were a significant number of candidates who did not attempt to plot the data for water loss. The responses of the rest revealed accurate plotting overall but there was some careless joining of the plotted points and a common omission was the fact that the two curves were not labelled despite the clear instruction to do so. It is possible that this is an example of candidates not reading questions carefully enough.

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(ii) Candidates should have given two times when the two curves intersected. One of these was clear from the table, 1600 hours. A surprising number quoted only one time and others selected times such as 1000 or 1300 hours when the lines on their graphs were clearly well apart.

(b) A significant number of candidates did not deal with decreases in temperature and humidity but the reverse. The effect of the decrease in either factor was more frequently identified than the reason for it. Explanations, when given, were often extremely confused biologically with the idea that plants obtain water from the atmosphere figuring prominently. The responses of a number of candidates indicated that they were unfamiliar with the term humidity.

Question 7

This question required a concise and detailed scientific explanation for the increase of food production. Many responses were very vague with little biological content and were hardly more than a rewording of the actual question. Candidates should have referred to specific minerals likely to be present in fertilisers and how their use by the plant would enhance crop production especially on soils that were naturally poor in minerals and on land that had been previously intensively farmed.

Question 8

Candidates should not start a question without reading it in its entirety. It was clear that some candidates did not do so and thus some information relevant to one term was muddled in the response to another term. The clearest responses were in **(a)**. In **(b)** many candidates confused the human ovum or egg cell, which is a single celled haploid gamete, with an ovule, that is basically a diploid multicellular structure present in flowering plants. These terms cannot be used synonymously. A common error is that candidates believe that fertilisation occurs within the ovary or that it involves a sperm fusing with an ovary. In **(c)** many candidates realised that implantation occurs in the uterus but few explained that it involved a ball of cells attaching to or sinking into the uterine lining.

Question 9

Candidates seemed to lack a basic understanding of the roles of structures associated with digestion. In **(a)** candidates tended to confuse where bile is stored with where it is made. Candidates should be aware that if they change their mind about a response they should cross out the original letter and write their new letter clearly separated from the original. In **(b)** candidates should have been able to identify **C** as the liver and **E** as the pancreas and responded appropriately. There were many vague responses that were not specific to either **C** or **E** such as "the production of enzymes", which are made by all cells, and not a reference to digestive enzymes or a named example. There were some candidates who gave the same function for both organs e.g. both **C** and **E** produced bile.

Question 10

(a) The concept of pollination seemed to be well understood although the origin and destination of the pollen was not always stated specifically.

(b) Both parts **(i)** an **(ii)** were frequently correctly answered. In **(iii)** very few candidates seemed to realise that plants **A**, **B** and **C** must each be isolated from one another and also from external pollinating agents. This could be simply achieved by covering the flowers with something like a paper bag. Self-pollination would then have to occur, possibly with the help of a human agent.

(c) Candidates should use the symbols given and not create other symbols to represent the alleles. This often led to confusion in the candidates' responses, especially when symbols such as **X** and **Y** were used. Candidates should be made aware that gametes only carry a single allele for any specific gene as in many cases candidates wrote in a pair of alleles in the circles. The offspring genotypes and phenotypes were often muddled. Candidates should understand that offspring genotypes should be shown as a pair of alleles, two symbol letters, and the phenotype by a word description of the feature. In this section candidates made multiple alterations that made the award of credit difficult or even impossible.

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BIOLOGY

Paper 0610/22
Core Theory

Key Messages

Success on this paper requires candidates to use the correct biological terms as much as possible. They also need to read all parts of a question with great care to ensure that they do not misunderstand what is required.

General Comments

There appeared to be sufficient time for most candidates to complete the paper and virtually no whole questions were left totally blank. **Questions 3, 7** and **8** proved very difficult to many candidates and sections of these questions were sometimes not attempted.

Some candidates showed limited knowledge and understanding of some topics in the syllabus especially the role of decomposers and genetics. Candidates need to be able to apply basic principles in less familiar situations. For exmaple in **Question 4** they needed to transfer their knowledge of the uptake of minerals by plants, digestion and assimilation to an unfamiliar mineral, phosphate.

Candidates need to be encouraged to read the whole of a question before beginning their response to any section and to think about the theme of the question. They should also note the mark distribution for each section of a question and make sure they have satisfied this. Candidates should be encouraged to use correct biological terminology in their responses to ensure it is understood by Examiners. The legibility of some scripts was a cause for concern to Examiners. Credit cannot be given if very poor writing or alterations mean that the candidate's response cannot be determined.

Comments on Specific Questions

Question 1

Despite the question stem referring to the fact that each specimen had four pairs of legs more than half of the candidates selected the wrong groups of arthropods with a significant proportion choosing crustaceans as the group. The commonest correct identifications in **(b)** were **C** and **E** while a significant number muddled **A** and **D**. Some candidates attributed the same name to two different arachnids although the five arachnids are clearly different species.

Question 2

(a) **N** was commonly correctly identified but sometimes **N** and **O** were muddled. The trachea was often misidentified as the oesophagus.

(b) Most candidates realised that the measurement of a rate involved a period of time but this had to be appropriate and thus "per second" or "per hour" were not acceptable. A very large proportion of the candidates suggested that the data could be obtained by counting heartbeat or the pulse as if these were the same as breathing. This suggests careless reading of the question or a misunderstanding of the two processes involved. It was expected that candidates should be able to offer a logical method such as feeling the rise and fall of the chest or the flow of air in and out of the nose.

(c)

(i)(ii) The vast majority of candidates were able to extract the relevant data.

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(iii) Many did not appreciate that a "pattern" should not refer to individuals but to whole groups. A significant number realised that breathing rate rose as a result of exercise and that the males tended to have higher breathing rates than females.

(d) Candidates very often started their responses with references to heart rate, continuing their errors from **(b)**. Sometimes they developed their response to eventually link this to breathing rate but not always. Most candidates realised that more oxygen was needed by the active muscles and a few linked this to a need for additional energy release. A number of candidates introduced anaerobic respiration in their responses and it was clear that they thought that during exercise anaerobic respiration replaces rather than supplements aerobic respiration.

Question 3

(a) There was evidence that candidates did not read the question carefully as many responses dealt with methods of dispersal rather than the advantages of the process to plants. Some did identify the reduced risk of overcrowding or the value of colonising new areas but few developed the former idea in terms of reduced competition with either the parent plant or other seedlings for water, light or minerals.

(b)

(i) Some candidates' responses implied that they thought that phototropism and photosynthesis were synonymous. A considerable number of candidates appeared to be totally unfamiliar with phototropism. Candidates should be aware that tropisms are growth responses triggered by directional stimuli. Candidates should also realise that different parts of plants respond in different ways to the stimulus of light.

(ii) A significant number of candidates were able to suggest the value of the response to shoots in gaining more access to light and roots gaining better anchorage or supplies of water and minerals.

Question 4

In this question candidates were expected to apply their knowledge and understanding of a variety of parts of the syllabus to an unfamiliar situation. Unfortunately the majority were unable to do this.

(a)

(i) The role of root hair cells in the uptake of mineral ions was commonly understood although few made reference to the mechanism of uptake involving differences in concentrations.

(ii) The question requests the name of a group of organisms and it is apparent from the diagram that these organisms release phosphate ions from the faeces produced by animals. Thus responses such as "soil, air, water and humans" gained no credit. It was expected that candidates would realise that decomposers such as bacteria and fungi have a role in all mineral cycles in nature.

(b) Candidates who utilised the information in the stem should have associated phosphates with bones and teeth. Also candidates should understand that in the digestive system materials have to be soluble to be absorbed by the villi.

(c) Candidates should have realised that faeces are rich in mineral ions, with named examples, and that these ions after release would be available for use by plants for future growth. Many responses were given in vague terms such as "food, goodness and fertilising the soil" and these gained no credit.

Question 5

(a) Candidates, when completing the table, linked the entry of oxygen into the blood to the lungs or more especially the alveoli but far fewer appreciated that insulin left the blood as this passed through the liver. Although many candidates related the removal of urea to the urinary system, relatively few selected the kidney as the organ involved. Many more chose structures such as the ureter, bladder and urethra that are involved with its removal from the body after it has already left the blood.

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(b) Most realised that clotting reduced blood loss from a cut and a significant number that it reduced the risk of bacteria or other pathogens entering the blood system. Unfortunately this latter concept was often dealt with in vague or erroneous terms such as "defeating or killing bacteria". Candidates should not just refer to germs or disease.

Question 6

(a)

(i) The acacia trees belong to the producer or first trophic level but candidates often just referred to this as primary which was considered inadequate as this could also refer to the primary consumer level.

(ii) Candidates need to be able to correctly identify primary and secondary consumers from a food web or chain.

(b) It was rare for candidates to not score full credit in **(i)** and many appreciated that the very large size of elephants made them unlikely prey of the carnivores in this web. There were a significant number who thought that the elephants were not linked to the predators because the elephants did not eat predators. This suggests that these candidates do not clearly understand the meaning of the arrows in a food web.

(c)

(i) A common response here was hyena. Candidates should be aware that the hyena is a scavenger and in this web is a secondary or tertiary consumer, not a decomposer. This response and that to **(ii)** suggested that the term decomposer is poorly understood.

(ii) Candidates should understand that decomposition and rotting are the same process. They should also appreciate the need for recycling of materials in an ecosystem if the eventual growth of the producers is not to be reduced or even cease altogether.

(d) The vast majority selected the relevant information and constructed a correct food chain.

Question 7

Some candidates correctly realised that herbicides killed weeds and thus reduced competition between the crop plants and the weeds for light, minerals, water and space. This allowed the crop to grow larger and faster than if the weeds were still present. Responses should include biological content and not simply be a re-wording of the actual question.

Question 8

(a) Most candidates did not understand that to measure growth in mass in plants, the plant is killed and dried before weighing. This is done in order to eliminate the very variable water content that can occur in such materials and can affect their fresh mass. Thus many responses suggested that the seeds were germinating in dry or drying soil and that this explained the nature of the curve. Candidates should be aware that during the early stages of germination the food reserves of the seed are used up, especially in respiration to release the energy needed for growth. The main waste products from respiration, water and carbon dioxide, are lost from the plant material.

(b) A number of candidates realised that photosynthesis was occurring. This was not accompanied by any explanation that when the shoot emerged above ground its leaves turned green when they were exposed to light. However candidates should also appreciate that photosynthesis must exceed respiration if the overall mass is to increase.

(c) Responses suggested that the question was not read with sufficient care as so many gave values based on the period from the lowest point of the curve to day 13, day 14 or even day 15 rather than a total of 13 days.

Question 9

(a) Very many candidates identified cell **A** and also stated its function and how the cell is adapted for this role, in **(ii)**. When referring to fertilisation, many candidates confused the human ovum or egg cell, which is a single celled haploid gamete, with an ovule, that is basically a diploid multicellular

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structure present in flowering plants. These terms cannot be used synonymously. Another common error is that candidates believe that fertilisation occurs within the ovary or that it involves a sperm fusing with an ovary. The identification of cell **B** was less commonly correct and thus this also affected the responses in **(iii)**. Of those who identified cell **B** as a white blood cell many of the functions offered in **(iii)** were rather vague such as "it fights disease" or were erroneous such as "prevents diseases entering the body".

(b) When completing the table the chromosome numbers for cells **A** and **B** were the most commonly correct. A limited number of candidates could recall that red blood cells have no nucleus and hence no chromosomes. Candidates should be advised that if they wish to alter a response they should clearly cross out the original and write, quite separately, a new response. Attempting to alter the original often makes it difficult for an Examiner to be sure of the candidates' intentions and to award credit.

Question 10

(a)

(i) Candidates should be able to explain the key genetic terms, such as homozygous.

(ii) The necessary information to decide whether the allele that causes thalassaemia was dominant or recessive was contained in the question stem in that parents without the condition can produce a child with thalassaemia; this means that the allele must be recessive. Candidates need practise at explaining their conclusions in genetics problems.

(iii) Many suggested that the genotype **Tt** was the full response. Careful reading of the question would have alerted them to the request for "genotypes" suggesting that there were at least two possibilities.

(b) Candidates should have used the symbols given in **(a)(iii)**, and not have created other symbols to represent the alleles. This often led to confusion in the candidates' responses. Candidates should be made aware that gametes only have a single allele for any specific gene and in many cases candidates wrote in a pair of alleles in the circles. The offspring genotypes and phenotypes were often muddled. Candidates should understand that offspring genotypes should be shown as a pair of alleles, two letters as symbols, and the phenotype by word descriptions of the feature. In this section candidates made multiple alterations that made the award of credit difficult or even impossible.

(c) Candidates needed to link a lack of iron to anaemia. Candidates were expected to suggest that anything that reduces the effectiveness of haemoglobin would reduce the delivery of oxygen around the body and thus reduce respiration and the amount of available energy for physical activity.

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BIOLOGY

Paper 0610/23
Core Theory

Key Messages

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Some candidates showed limited knowledge and understanding of some topics in the syllabus especially the role of decomposers and genetics. Candidates need to be able to apply basic principles in less familiar situations. For example in **Question 4** they needed to transfer their knowledge of the uptake of minerals by plants, digestion and assimilation to an unfamiliar mineral, phosphate.

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Comments on Specific Questions

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Despite the question stem referring to the fact that each specimen had four pairs of legs, more than half of the candidates selected the wrong groups of arthropods with a significant proportion choosing crustaceans as the group. The commonest correct identifications in **(b)** were **C** and **E** while a significant number muddled **A** and **D**. Some candidates attributed the same name to two different arachnids although the five arachnids are clearly different species.

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(a) **N** was commonly correctly identified but sometimes **N** and **O** were muddled. The trachea was often misidentified as the oesophagus.

(b) Most candidates realised that the measurement of a rate involved a period of time but this had to be appropriate and thus "per second" or "per hour" were not acceptable. A very large proportion of the candidates suggested that the data could be obtained by counting heartbeat or the pulse as if these were the same as breathing. This suggests careless reading of the question or a misunderstanding of the two processes involved. It was expected that candidates should be able to offer a logical method such as feeling the rise and fall of the chest or the flow of air in and out of the nose.

(c)

(i)(ii) The vast majority of candidates were able to extract the relevant data.

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(iii) Many did not appreciate that a "pattern" should not refer to individuals but to whole groups. A significant number realised that breathing rate rose as a result of exercise and that the males tended to have higher breathing rates than females.

(d) Candidates very often started their responses with references to heart rate, continuing their errors from **(b)**. Sometimes they developed their response to eventually link this to breathing rate but not always. Most candidates realised that more oxygen was needed by the active muscles and a few linked this to a need for additional energy release. A number of candidates introduced anaerobic respiration in their responses and it was clear that they thought that during exercise anaerobic respiration replaces rather than supplements aerobic respiration.

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(a) There was evidence that candidates did not read the question carefully as many responses dealt with methods of dispersal rather than the advantages of the process to plants. Some did identify the reduced risk of overcrowding or the value of colonising new areas but few developed the former idea in terms of reduced competition with either the parent plant or other seedlings for water, light or minerals.

(b)

(i) Some candidates' responses implied that they thought that phototropism and photosynthesis were synonymous. A considerable number of candidates appeared to be totally unfamiliar with phototropism. Candidates should be aware that tropisms are growth responses triggered by directional stimuli. Candidates should also realise that different parts of plants respond in different ways to the stimulus of light.

(ii) A significant number of candidates were able to suggest the value of the response to shoots in gaining more access to light and roots gaining better anchorage or supplies of water and minerals.

Question 4

In this question candidates were expected to apply their knowledge and understanding of a variety of parts of the syllabus to an unfamiliar situation. Unfortunately the majority were unable to do this.

(a)

(i) The role of root hair cells in the uptake of mineral ions was commonly understood although few made reference to the mechanism of uptake involving differences in concentrations.

(ii) The question requests the name of a group of organisms and it is apparent from the diagram that these organisms release phosphate ions from the faeces produced by animals. Thus responses such as "soil, air, water and humans" gained no credit. It was expected that candidates would realise that decomposers such as bacteria and fungi have a role in all mineral cycles in nature.

(b) Candidates who utilised the information in the stem should have associated phosphates with bones and teeth. Also candidates should understand that in the digestive system materials have to be soluble to be absorbed by the villi.

(c) Candidates should have realised that faeces are rich in mineral ions, with named examples, and that these ions after release would be available for use by plants for future growth. Many responses were given in vague terms such as "food, goodness and fertilising the soil" and these gained no credit.

Question 5

(a) Candidates, when completing the table, linked the entry of oxygen into the blood to the lungs or more especially the alveoli but far fewer appreciated that insulin left the blood as it passed through the liver. Although many candidates related the removal of urea to the urinary system, relatively few selected the kidney as the organ involved. Many more chose structures such as the ureter, bladder and urethra that are involved with its removal from the body after it has already left the blood.

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(b) Most realised that clotting reduced blood loss from a cut and a significant number that it reduced the risk of bacteria or other pathogens entering the blood system. Unfortunately this latter concept was often dealt with in vague or erroneous terms such as "defeating or killing bacteria". Candidates should not just refer to germs or disease.

Question 6

(a)

(i) The acacia trees belong to the producer or first trophic level but candidates often just referred to this as primary which was considered inadequate as this could also refer to the primary consumer level.

(ii) Candidates need to be able to correctly identify primary and secondary consumers from a food web or chain.

(b) It was rare for candidates to not gain full credit in **(i)** and many appreciated that the very large size of elephants made them unlikely prey of the carnivores in this web. There were a significant number who thought that the elephants were not linked to the predators because the elephants did not eat predators. This suggests that these candidates do not clearly understand the meaning of the arrows in a food web.

(c)

(i) A common response here was hyena. Candidates should be aware that the hyena is a scavenger and in this web it is a secondary or tertiary consumer, not a decomposer. This response and that to **(ii)** suggested that the term decomposer is poorly understood.

(ii) Candidates should understand that decomposition and rotting are the same process. They should also appreciate the need for recycling of materials in an ecosystem if the eventual growth of the producers is not to be reduced or even cease altogether.

(d) The vast majority selected the relevant information and constructed a correct food chain.

Question 7

Some candidates correctly realised that herbicides killed weeds and thus reduced competition between the crop plants and the weeds for light, minerals, water and space. This allowed the crop to grow larger and faster than if the weeds were still present. Responses should include biological content and not simply be a re-wording of the actual question.

Question 8

(a) Most candidates did not understand that to measure growth in mass in plants, the plant is killed and dried before weighing. This is done in order to eliminate the very variable water content that can occur in such materials and can affect their fresh mass. Thus many responses suggested that the seeds were germinating in dry or drying soil and that this explained the nature of the curve. Candidates should be aware that during the early stages of germination the food reserves of the seed are used up, especially in respiration to release the energy needed for growth. The main waste products from respiration, water and carbon dioxide, are lost from the plant material.

(b) A number of candidates realised that photosynthesis was occurring. This was not accompanied by any explanation that when the shoot emerged above ground its leaves turned green when they were exposed to light. However candidates should also appreciate that photosynthesis must exceed respiration if the overall mass is to increase.

(c) Responses suggested that the question was not read with sufficient care as so many gave values based on the period from the lowest point of the curve to day 13, day 14 or even day 15 rather than a total of 13 days.

Question 9

(a) Very many candidates identified cell **A** and also stated its function and how the cell is adapted for this role, in **(ii)**. When referring to fertilisation, many candidates confused the human ovum or egg cell, which is a single celled haploid gamete, with an ovule, that is basically a diploid multicellular

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structure present in flowering plants. These terms cannot be used synonymously. Another common error is that candidates believe that fertilisation occurs within the ovary or that it involves a sperm fusing with an ovary. The identification of cell **B** was less commonly correct and thus this also affected the responses in **(iii)**. Of those who identified cell **B** as a white blood cell, many of the functions offered in **(iii)** were rather vague such as "it fights disease" or were erroneous such as "prevents diseases entering the body".

(b) When completing the table, the chromosome numbers for cells **A** and **B** were the most commonly correct. A limited number of candidates could recall that red blood cells have no nucleus and hence no chromosomes. Candidates should be advised that if they wish to alter a response they should clearly cross out the original and write, quite separately, a new response. Attempting to alter the original often makes it difficult for an Examiner to be sure of the candidates' intentions and to award credit.

Question 10

(a)

(i) Candidates should be able to explain the key genetic terms, such as homozygous.

(ii) The necessary information to decide whether the allele that causes thalassaemia was dominant or recessive was contained in the question stem in that parents without the condition can produce a child with thalassaemia; this means that the allele must be recessive. Candidates need practise at explaining their conclusions in genetics problems.

(iii) Many suggested that the genotype **Tt** was the full response. Careful reading of the question would have alerted them to the request for "genotypes" suggesting that there were at least two possibilities.

(b) Candidates should have used the symbols given in **(a)(iii)**, and not have created other symbols to represent the alleles. This often led to confusion in the candidates' responses. Candidates should be made aware that gametes only have a single allele for any specific gene and in many cases candidates wrote in a pair of alleles in the circles. The offspring genotypes and phenotypes were often muddled. Candidates should understand that offspring genotypes should be shown as a pair of alleles, two letters as symbols, and the phenotype by word descriptions of the feature. In this section candidates made multiple alterations that made the award of credit difficult or even impossible.

(c) Candidates needed to link a lack of iron to anaemia. Candidates were expected to suggest that anything that reduces the effectiveness of haemoglobin would reduce the delivery of oxygen around the body and thus reduce respiration and the amount of available energy for physical activity.

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BIOLOGY

Paper 0610/31
Extended Theory

Key Messages

- Candidates should be encouraged to read each section of a question with care before beginning their response and to think carefully if they find themselves giving identical responses to two sections of a question.
- Candidates should be encouraged to use the correct scientific terms in their answers e.g. 'habitat' not 'homes'.
- Candidates should be able to analyse the graphs provided and they should include enough numerical data to justify their observations and not simply make generalised statements.
- Where required in a question, candidates should make full and accurate use of the data provided.
- Candidates should always take care to use the correct spelling for names of structures or functions; the Examiners will always reward phonetic spellings so long as there is no confusion with another term that candidates should know from the syllabus.

General Comments

The paper offered a variety of questions which discriminated well between the candidates; it allowed them to interpret information which was presented in different ways.

There was evidence that several candidates struggled with the concepts from the supplementary part of the syllabus and they might have performed better in Paper 2. Care should be taken when selecting the most appropriate route for candidates.

There were few signs of candidates having time constraints and in general all the questions were attempted. There were relatively few that were not attempted and left blank.

Some papers proved to be difficult to read as the handwriting was not clear and there was some evidence of candidates writing answers in pencil which were inked in later. This should be discouraged as it risks the answer being illegible.

Questions 1(a), **1(b)**, **1(c)**, **2(b)**, **2(d)**, **3(a)** and **6(a)** proved to be the most straightforward and allowed the candidates to demonstrate recall of material in the syllabus on classification and plant reproduction. The reflex arc in **Questions 2(b)** and **2(d)** was well known.

Questions 4(a), **4(c)**, **4(d)**, **4(e)**, **5(c)** and **6(c)** proved to be more challenging.

Most of **Question 4** on penicillin production proved to be more taxing and in **4(a)** only the higher scoring candidates took due note of the mark allocation and used the information provided in the diagram to explain fully the need for the water jacket and the addition of acids and alkalis.

Detailed comments on candidate performance and strengths and weaknesses per question can be found below.

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Comments on Specific Questions

Question 1

(a) Most candidates were able to give the correct answer as *Lilium*. The most common error was to give both parts of the name.

(b) This question required candidates to identify parts of a flower from a photograph of *Lilium tigrinum* and many candidates gained full credit here. There was sometimes confusion between **A** (stigma) and **D** (style), but petal and anther were usually identified correctly.

(c) Most candidates were able to give at least one correct answer here, with 'parallel veins' and 'narrow leaves' being the most common features recognised. Some candidates did not give proper attention to the word 'visible' in the question and references to 'number of cotyledons' or 'arrangement of vascular bundles' were irrelevant.

(d) This was generally well answered with many candidates appreciating that sexual reproduction allows variation and evolution, but may need two plants and/or pollinating agents. There was sometimes some confusion and references to 'flower' instead of 'plant' and to 'fertilisation' or 'pollination' occurring in asexual reproduction. In some cases, ideas were often correct, but needed to be explained more concisely.

Question 2

(a) Many candidates did not gain full credit here. It was common to see only half of the definition. The idea of a response was often omitted and a specific human sense was described rather than the general definition.

(b) Labelling of the skin receptors and sensory neurone were mostly correct, but lines for **H** that went onto the motor end plate did not gain credit. Candidates should have used label lines but some placed a letter next to the relevant part, or sometimes not close enough to the intended part to make the answer clear.

(c) Most candidates appreciated that an involuntary action did not require thought; better answers stated that it was automatic and that the stimulus would always produce the same response. However, some answers simply gave specific examples of involuntary actions and their advantages to the body, which was more applicable to **(d)**.

(d) This question prompted a number of good answers, with candidates describing an example which illustrated fully the rapid and protective nature of many reflexes allowing the body to avoid injury.

(e) The effect of adrenaline on the body was described reasonably well by many candidates with most stating that there would be an increase in heart rate and in breathing rate. Many understood the need to divert blood from the gut and skin with the corresponding vasodilation in muscles. Better answers also referred to the fact that adrenaline stimulates the breakdown of glycogen in the liver which will then increase blood glucose concentration, but weaker answers could not gain any credit for confusing the action of adrenaline in actually breaking the glycogen down. Some answers were imprecise and described adrenaline as speeding-up nerve impulses. Some candidates simply listed examples of situations in which adrenaline would be released.

Question 3

(a) Many candidates wrote a balanced equation for respiration and gained full credit. Some gave word equations but these were not credited. Occasionally the formula for glucose was written incorrectly.

(b) This question asked the candidates to state three variables that should be kept constant when using a simple respirometer. Some candidates gained full credit here and most gained at least partial credit for stating temperature. Better answers also referred to measurable variables, such as mass of soda lime or mass of peas, but many simply stated 'soda lime' or 'peas' which gained no credit. Several quoted 'length of time' although this was in the stem of the question.

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(c)

(i) Most candidates described correctly the direction in which the droplet would move. They explained that this movement was caused by the absorption of oxygen and the giving out of carbon dioxide which was then absorbed by the soda lime. The resultant pressure changes were linked correctly to the droplet movement by many candidates. There was some confusion with photosynthesis, which would not have started in the seeds at this stage.

(ii) Many candidates recognised that the movement of the droplet slowed down after three minutes because the rate of respiration was slowing as oxygen was being used up. More able candidates went on to explain that as the rate of aerobic respiration slowed down, the seeds would begin to respire anaerobically. Answers that did not gain credit included 'respiration stops' without any reference to aerobic or anaerobic.

Question 4

(a) Most candidates gained partial credit for describing how the water jacket would prevent overheating and maintain a constant temperature within the fermenter which would then provide optimum conditions for the fungal enzymes. Denatured was a term that was not used by all candidates and some stated that enzymes are 'killed' or 'die' at higher temperatures. Only the more able candidates went on to explain why the temperature in the fermenter would rise without the use of the cooling water jacket and then went on to gain credit for describing that respiration of the fungus would release heat, which if not controlled would kill the fungus.

The need to add acids or alkalis was also generally understood, and most candidates appreciated that these would keep the pH within the fermenter constant to provide the optimum pH for enzyme activity. The most common error was to assume that the fungal enzymes would work best at a neutral pH.

(b)

(i) Almost all candidates correctly identified the time interval over which the fungus grew at its maximum rate, although some misread the scale of the graph and gave the time interval as 40-45 hours.

(ii) Mitosis was often recognised and although the question asked for the type of nuclear division, binary fission was a common error.

(iii) Candidates were asked to explain why the growth of the fungus slowed down and stopped. Although many appreciated that the nutrients would have been used up, few went on to gain full credit by explaining that there might have been other limiting factors or to give examples of what these limiting factors might be. More able candidates recognised that carrying capacity may have been reached; they also stated that there was the possibility that toxic waste products would have been produced or even that the accumulation of penicillin would inhibit growth.

(c)

(i) Many responses showed that candidates had used information from the graph to explain that the fungus grew without the presence of penicillin during the first twenty hours. Some candidates compared the graph curves or wrote that the penicillin carried on increasing after fungal growth had stopped. Others stated incorrectly that the fungus could grow without the penicillin as there was no sign of the penicillin being used up as the fungus was growing.

(ii) Most recognised that they did not allow the fermentation to continue as penicillin production had already stopped and therefore no more penicillin would be produced.

(d) Many candidates did not understand the reference to downstream processing and their answers were often too imprecise to gain credit, mainly relating to making the penicillin fit for human consumption. Some candidates gained credit for recognising the need for separating or purifying the penicillin from any waste products, but only the more able candidates appreciated the need for concentrating the penicillin and making into pills.

(e) The most common answer was to describe viruses as not being alive rather than not having any cellular structure or metabolism. The common error with candidates who attempted to explain their action was to state that antibiotics would destroy the bacterial cell walls rather than stopping their

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growth. Several referred to the viruses changing so fast that the antibiotics could not keep up with them. There was some confusion between the terms 'antibiotics' and 'antibodies'.

Question 5

(a) Most candidates gained at least partial credit here for recognising that the blood would be less efficient at transporting oxygen and the subsequent fatigue which would be felt by the person with sickle cell anaemia. Good answers went on to include the blocking of capillaries which would cause pain, death of tissues linked to poor oxygen supply and the longer term effects such as poor growth and reduced life span. No credit was awarded when candidates answered in terms of no oxygen transported by the blood which would lead to no respiration and death.

(b)

(i) Generally candidates tended to gain either full credit or gain very little in this genetics question. Common errors included using other symbols or using upper and lower case letters (suggesting dominant and recessive) which were credited as an error carried forward if the rest of the diagram was correct. Some candidates gave single alleles for parental genotypes or pairs of alleles in the gametes, even though they then went on to complete successfully a Punnett square to illustrate the cross. Some candidates correctly completed the genetic diagram but then labelled the offspring phenotypes incorrectly.

(ii) Some candidates gave the chance as a ratio and therefore did not gain credit. A wide range of formats was allowed, including a fraction, a decimal figure and a percentage.

(c) Many candidates recognised the connection between the occurrence of malaria and the high proportion of people with the sickle cell trait. However, they often did not gain credit here because they answered in terms sickle cell trait providing immunity from malaria, or that it would prevent the disease, i.e. give complete protection, rather than giving resistance or less chance of getting malaria.

(d) This question asked the candidates to discuss whether sickle cell trait is an example of codominance and was generally not answered well as the concept was often poorly understood. Better answers included reference to the fact that both the alleles would be expressed in the phenotype to produce two different forms of haemoglobin. The reverse argument was also credited. A common error was to ignore the fact that there are three different phenotypes and attempted to explain the condition as if it was a matter of dominant and recessive alleles. Many candidates did not use the term *allele* within their answer.

Question 6

(a) Most candidates scored highly on this question and could define a population as being a group of organisms of the same species living in a particular area or habitat. Many also stated that this would be at the same time although few referred to the ability to interbreed successfully. A common error was to define simply in terms of the human population.

(b) This question asked the candidates to use data in the form of a graph to describe the effect of pesticides on populations of the brown plant hopper. Better answers described how the number of hoppers was low initially and that this low number was maintained when the spraying occurred. There was a rapid increase in numbers when the spraying stopped which reached a maximum at approximately day sixty-eight and then there was a rapid fall in population. Credit was given for using data provided by the graph. Some candidates misunderstood the figure and thought that the rice plants were transplanted after the spraying, which affected their time-point references. This question was not well understood and many candidates did not include any data to support their descriptions. Many attempted to answer this in terms of development of resistance to pesticide, rather than using the information provided in the figure. The question asked for a description of the effect, not an explanation.

(c) Many candidates understood how systemic pesticides work by being absorbed into the plant and transported in the phloem, then to be ingested by the insect as it feeds on the plant. They easily received full credit. Others did not appreciate the mode of action and described a type of pesticide where the chemical is taken back to the nest to kill others.

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(d) Some answers were often too imprecise and did not use comparative figures provided by the graph to explain the advantages of using predators, such as spiders, to control brown plant hoppers. Many candidates explained that this would be effective at controlling the numbers and that it would prove to be a more economical method of control with less pollution. Better answers used the figures to explain how the spiders would be effective at reducing the number of hoppers and preventing any population explosion. Candidates rarely stated that other advantages are that harmless species are not killed and there is no accumulation of a pesticide along the food chain. Many candidates continued the theme from **(b)** and appreciated that there would not be any development of resistance using this type of control as opposed to using pesticides.

(e) The Examiners saw some very good descriptions of the long-term effects of deforestation on the environment and almost all candidates gained at least partial credit here, with soil erosion, loss of habitat, extinction of species and carbon dioxide increase being the main effects quoted. Better answers also included reference to increased silting of rivers and flooding. Some candidates wrote lengthy but vague accounts relating to the effect of deforestation on the level of oxygen in the atmosphere and how this would cause the demise of animals, which could not gain any credit.

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BIOLOGY

Paper 0610/32
Extended Theory

Key Messages

- Candidates must read and understand the importance of all the information provided in questions.
- When asked to explain how structures are adapted to the functions they carry out, candidates should organise their answers appropriately rather than simply describe the process.
- Candidates should be encouraged to use the correct scientific terms in their answers e.g. bacteria, fungi and/or viruses and not 'germs'.
- 'Describe' and 'Explain' are often confused and may be encountered in different sections of the same question. Candidates should be careful not to repeat their description in a section that asks for an explanation.
- Candidates should always take care to use the correct spelling for names of structures or functions; the Examiners will always reward phonetic spellings so long as there is no confusion with another term that candidates should know from the syllabus.

General Comments

The Examiners marked a number of excellent scripts which displayed a thorough understanding of all the topics examined in this paper. There were some candidates who would have performed better on Paper 2 rather than on this paper with its more demanding questions that require a wider range of interpretive skills. Care should be taken when selecting the most appropriate route for candidates.

Two part questions gave candidates problems. In **Questions 4(c)(ii)** and **5(c)(ii)**, they were asked about experimental techniques. These questions required some careful analysis of the information provided which was often not in evidence. Candidates obviously need more practice at evaluating information that they are given and thinking critically.

Comments on Specific Questions

Question 1

(a) Many candidates identified the four parts of the heart correctly. Common mistakes included identifying the bicuspid valve (**B**) as the tricuspid and the semi-lunar or aortic valve (**C**) as the bicuspid or tricuspid valve. Almost all candidates identified the left atrium (**A**) and the right ventricle (**D**) correctly. The Examiners accepted all the commonly accepted alternative names for the left atrium and the valves, including the atrioventricular valve for **B**. Many candidates gave their answer for **A** as an artery and **B** and **C** as unqualified valves. Spellings had to be correct or phonetic; hence misspellings such as 'biscupid' were not accepted.

(b) The two blood vessels that had to be identified were the superior vena cava and the aorta. Candidates tended either to get both right or both wrong. The most common mistake was to identify the vessels as pulmonary artery and pulmonary vein. Many candidates just wrote 'artery' and 'vein'. In some cases, correct names of the vessels were reversed so no credit could be awarded.

(c) Credit was available for correct identification of the arteries that supply the heart muscle. The same mistake was noticed in many scripts as the coronary arteries were identified as pulmonary

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arteries. Also common were 'carotid arteries' and 'cardiac arteries'. Some candidates gave a list from which the Examiner could choose. Many candidates explained that fat is deposited in the wall of the artery, although it was not always clear that fat was 'building up' in the wall rather than in the lumen or on the outside. Most then stated that there would be a blockage in the artery. Better answers went further to explain that blood supply to heart muscle would be restricted and that blood might clot. A few candidates gave very thorough descriptions of atherosclerosis, but some candidates interpreted 'diseased' as the result of an infectious disease or contamination during the operation. Some candidates thought that the disease was a consequence of the use of the heart lung machine, either as result of damage to the vessels or the use of non-sterile equipment. Quite a few candidates went down the 'smoking causes …..' route to answer the question. Those that explained that less oxygen would pass to the heart left it unclear as they rarely included 'to cardiac muscle' in their answers so that there was confusion with supply of oxygenated blood from the pulmonary veins to the left atrium.

(d) The heart lung machine depicted in Fig. 1.1 is used to oxygenate the blood and then pump oxygenated blood to the body. It fulfils the functions of the lungs and the heart. A number of candidates suggested in their answers that the machine pumped blood to the lungs to be oxygenated and also implied that the heart was still pumping during the operation. The question was misinterpreted by many candidates who explained why it was important that the heart was stopped rather than focusing on the role of the machine.

(e) The Examiners read many excellent explanations of the structure of the heart related to the pumping of blood at two different pressures. Many were able to identify the difference in thickness of the two ventricles as the key point to make. Most who did this gained full credit. Common errors were to write answers without mentioning the ventricles at all and refer instead to the two 'sides' of the heart and imply that the two atria have walls of different thickness. Some candidates described the action of the heart in pumping blood into the pulmonary and systemic circulations without referring to the different blood pressures which was the point of the question. Many simply described the path that blood took from entering at the vena cava and exiting at the aorta again with no references to ventricles, contraction or pressure. Few candidates mentioned the septum and often those that did rarely mentioned anything else. Surprisingly few stated the fact that the heart is made of muscle.

There were two more common problems with answers to this question. Many answers concentrated on the structure of the arteries and veins and how they withstand different blood pressures. The heart was occasionally not described as generating the pressure, but having a thick wall 'to withstand the high blood pressure'.

Question 2

In general, **(c)** and **(d)** were not answered very well. The term *impulse,* although used in the question, was not often used; instead, 'messages' and 'signals' were more normal. General confusion appeared to exist between the role of motor and sensory neurones; in many cases, impulses were travelling in the wrong direction.

(a) Most candidates defined movement in terms of moving the whole organism or part of an organism from place to place or referred to a change in position. Those who did not gain credit here often used the word *move* in their definition without giving the effect of that movement. Some referred to a stimulus 'causing movement', but with no explanation of what that movement involved.

(b)

(i) The antagonistic action of the two muscles shown in Fig. 2.1 was given by many. A common mistake was to give 'reflex action' or 'reflex arc' as the answer.

(ii) This is an example of a question where full use should have been made of the information given. There were many excellent explanations of the movement about the elbow joint. Many candidates understood the antagonistic role of the biceps and triceps, but did not always link this to the correct movement of the arm. Candidates who implied that the arm moved up did not gain credit as the description ignored the elbow joint and implied that movement was from the shoulder. Those who simply stated that when 'one muscle contracts, the other relaxes' gained credit. Many candidates explained both flexion and extension. A few got the wrong action for the contraction of the muscles and the wrong result.

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(c)

(i) To gain full credit, candidates had to explain that the sensory neurone **J** transmits impulses from a receptor to the spinal cord. The Examiners accepted a variety of alternatives for both marking points. Common mistakes were to omit any reference to a receptor and to state that impulses travelled to the brain and that the stimulus, pain or heat travelled along the nerve. Some candidates gave descriptions of the full reflex arc or described what happens between the spinal cord and the effector. There were a pleasing number of references to muscles contracting and pulling on bones.

(ii) Fig. 2.1 shows that there are impulses in neurone **G** to the biceps, but not in neurone **H** to the triceps. Candidates were expected to explain that impulses stimulate muscles to contract and that in this example of a reflex action the biceps are the muscles that contract to move the forearm upwards. Here, and in **(d)**, some candidates had nerves contracting rather than transmitting impulses. Again there were many 'signals' and 'messages', but most gained credit for the contraction of the biceps.

(d) Some candidates gave good explanations of the control of muscles in voluntary actions and they were clear about the role of the brain making decisions or acting to coordinate the actions of the muscles. Many candidates were still thinking about involuntary actions, such as the reflex action in Fig. 2.1, and referred to the spinal cord and to impulses travelling to single muscles. Voluntary actions are more complex and involve the action of many neurones and muscles. Some candidates did not mention the involvement of the brain although they did refer to conscious decisions or some other, similar phrase. Where the brain was mentioned, credit was often not awarded as candidates wrote that the brain 'was conscious of the movement' which is not sufficiently precise an answer as there was no reference to a decision.

Question 3

(a) There were many good accounts of water absorption by the fibrous roots of sweet potato. Many candidates used the term *water potential* correctly referring to osmosis and the partially permeable membranes of root hair cells. There were many who wrote about water concentrations in spite of the instruction in the question. Common errors were to omit a reference to root hairs as the site of absorption and to state that water is absorbed by active transport instead of, or as well as, by active uptake.

(b) This question asked how root hair cells are adapted for the absorption of ions from the soil; it did not ask how they absorb ions. Candidates who simply described the absorption by active uptake often gained partial credit, but were unlikely to gain full credit. Successful answers referred to the large surface area of these cells and to the presence of mitochondria that provide energy for active uptake. Some candidates stated that root hair cells have thin cell walls and some responded to the reference to proteins in the question. Candidates who stated that proteins in membranes act as carriers or channels for the active uptake of ions gained credit. Many referred to thin membranes rather than to thin cell walls. Some candidates wrote about the cells themselves being thin, which did not gain any credit. Some also mentioned the carrier proteins but then went on to say that they are broken down to release energy for the movement of the ions. Many stated that mitochondria 'produce' energy, which also was not credited.

(c) Many candidates completed the life cycle of sweet potato by putting 90 as the chromosome number for the adult and the zygote, and 45 for the female gametes. Many did not read the question carefully and gave 46 as the diploid number and 23 as the haploid; some even gave 2n and n. Some gave combinations of other numbers. If the answers were incorrect, but the number for the female gametes was half that given for the adult and zygote, then partial credit was awarded. Some answers showed no knowledge of this simple principle.

(d) In this question, candidates were asked to state two advantages and two disadvantages of asexual reproduction for plants, such as sweet potato. Many candidates showed a good understanding of the principles giving concise answers that clearly matched those expected. Sometimes, it appeared that candidates were offering disadvantages of self-pollination, rather than asexual reproduction. In some cases, the disadvantages are the same but some candidates who stated that only one parent is required, often did not receive credit by stating that pollen lands on the stigma of the same plant or that fertilisation is much more likely to happen. Some answers referred to the identical nature of the offspring from one parent, but did not always make it clear how this

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was a disadvantage. Some also said this was an advantage, but also did not explain how it might be. Little or no variation was credited, but not the comparative 'less variation' because this could still be quite an appreciable amount of variation.

Question 4

(a)

(i) Many candidates gave lymphocyte as the correct answer for the type of cell that secretes antibodies. Phagocyte was the most common incorrect answer. Platelets were also seen as well as leucocyte and thrombin.

(ii) Good answers often started by stating that antibodies attach to bacteria, viruses and pathogens. There were many vague and incorrect answers to this question about the role of antibodies in providing protection for the body. Many gave functions that are those of *antibiotics* rather than antibodies. The idea of attachment was given in a variety of ways, but no credit was awarded for antibodies 'attacking' or 'fighting' pathogens. Some candidates explained that antibodies help phagocytes to engulf bacteria, but others stated that the antibody did the engulfing and then secreted the enzymes needed for digesting the bacteria. There were a few very pleasing references to opsonisation. Bacteria were also said to be 'stuck together' by antibodies, but rarely was this idea taken further in that aggregations could be removed more easily by phagocytes, so that bacteria do not spread throughout the body.

(b)

(i) Most candidates identified blood clotting as the time when thrombin catalyses the reaction to change fibrinogen to fibrin. Quite a few candidates identified this reaction as occurring in digestion.

(ii) There were many good answers describing how fibrin protects the body. Few candidates explained that fibrin is insoluble, but many stated that it forms a mesh or network that traps red blood cells and/or platelets and dries to form a scab. Many also explained that it prevents the loss of blood and the entry of pathogens. Some candidates confused fibrin with fibre and wrote of the importance of fibre in the diet.

(c)

(i) Candidates found it much easier to explain the lack of activity of thrombin at 70 °C than the low activity at 5 °C. Many stated that the enzyme would be denatured at the high temperature, although fewer went on to explain that the enzyme changes its shape. Better answers referred to the change in shape of the active site. Candidates who stated that denatured enzymes are dead were not credited with the marking point for 'denature'. At the low temperatures, there is little kinetic energy and few collisions between enzyme and substrate molecules. Most candidates simply stated that there is little activity without giving a reason or said that the enzyme is inactive at that temperature. Very few referred to the lower kinetic energy at 5 °C, but those that did also mentioned a low frequency of collisions between substrate and enzyme.

(ii) There were some excellent answers, but few candidates appeared to understand that the activity of thrombin was determined by finding out how long it takes for fibrin to form. The Examiners accepted some variations on this answer, but not 'how long it takes for a scab to form'. The significance of the time involved was rarely appreciated, although some attempts that included references to the arbitrary units on the *y*-axis of the graph indicated an awareness of there being something more involved than just the action of thrombin.

(iii) Many candidates forgot that in this investigation temperature was the independent variable and wrote the two variables that are often answers to this type of question: temperature and pH. Better answers identified the volume and/or concentration of enzyme (thrombin) or substrate (fibrinogen). The Examiners accepted 'amount' as equivalent to concentration, although whether that was what the candidates intended was unclear.

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Question 5

(a) Many candidates gave two or three characteristic features of birds visible in the photograph of a reed warbler in Fig. 5.1. The Examiners accepted 'wings', 'beak', 'feathers' and 'scales of feet or legs' but not 'hair' or 'fur'.

(b)

(i) Candidates need practise at explaining unfamiliar examples of variation. Many candidates found it difficult to explain why the wing length of reed warblers is an example of continuous variation. Few stated that it is a quantitative feature and many struggled to explain that there is a range of wing lengths between the extremes. Many, however, stated that it is influenced by the environment and explained why it is not discontinuous variation. Many stated that the birds' wings get larger as they grow older in spite of the information given in the question. Continuous variation was described as a continuous change throughout life by many candidates, for example: 'the wings grow throughout their life'. There were also many answers such as: 'each bird has different wing lengths' implying that all birds are different from one another. These answers were not credited.

(ii) There were many suitable suggestions for other features of reed warblers that show continuous variation. The Examiners accepted the length of anything suitable such as tail, beak, legs or wings and body mass. They did not accept colour which was given quite frequently or the vague 'size' including 'size of beak'. Some suggested measuring the dry mass of the warblers, which was considered too extreme. Age was accepted, but not 'mean age' as given by some candidates.

(c)

(i) The question stated that the researchers thought that reed warblers with wing lengths of 66 to 67 mm had the best chance of survival. Candidates were asked to describe the evidence from Table 5.1 that supported this conclusion. Most answers stated that the largest numbers of birds trapped were in this category and that they also had the oldest mean age. Many supported these statements with the data for birds of wing length 66 to 67 mm, but rarely did they make these comparative by stating, for example, that about half the birds trapped were in that category or that the mean age of these birds was about 350 days whereas none of the other groups had a mean age as great as 300 days. Often candidates had not looked at the table carefully and thought that the number of days referred to how long the birds took to be caught or how long they were held in captivity.

(ii) As with **Question 4(c)(ii)**, candidates were not successful at answering a question on experimental techniques. Here they were asked to suggest other evidence that researchers could collect to show that birds with wing lengths of 66 to 67 mm had the best chances of survival. Many candidates repeated the answer that they had already given in **(i)**; others gave assertions rather than suggest the evidence that could be collected. Many answers were imprecise, but there were a small number of good answers that showed that candidates had thought about the limitations of the data provided and ways to improve it. Suitable suggestions are given in the mark scheme, but the Examiners considered each answer on its merits. Any aspect of the birds' biology that was appropriate and could be investigated was credited so long as it related to the survival of birds with different wing lengths.

(d) Many candidates understood that they should apply points that they had learnt about natural selection to this example. Good answers stated that birds with wing length of 66 to 67 mm survive or live longer and breed. As a result they pass on their alleles for wing length. Candidates did not always make it clear that there were any genes and alleles for wing length and that this was an important point to make. Some candidates also explained that birds with smaller and larger wings die and so do not breed to pass on their alleles; these points gained credit. Some candidates thought that this was a question about *artificial* selection and gained no credit. Other problems were those answers that referred to 'birds with this wing length breeding together' and to dominant and recessive alleles for wing length. Many gave general accounts of the survival of the fittest without referring to the wing length.

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Question 6

(a) Candidates often identified the enzymes correctly as amylase, protease and lipase. Many incorrect answers were seen including 'maltase', which was quite common, and pepsin and trypsin which are not appropriate in this context. Ptyalin is a term for salivary amylase that should not be used in this context.

(b) Almost all candidates could suggest a reason for treating sewage. Many stated that it avoids polluting the environment. There were some good answers about eutrophication and the spread of disease.

(c) There were some good answers to this question about why oxygen is bubbled through the tank at stage 5. Most correct answers explained that the oxygen is used for aerobic respiration in microorganisms and referred to the energy released and digestion of the sewage. Few realised that this is a fermenter similar in many ways to the fermenters they would have studied with respect to penicillin and singe cell protein production. For example, there were few references to the bacteria multiplying. Only a tiny minority stated that the oxygen would mix the microorganisms with the sewage so speeding up the digestion process. Some candidates answered this question in terms of providing oxygen for aquatic life in the river after discharge of effluent from the sewage works and mentioned biological oxygen demand. Many of those that mentioned respiration did not go further and suggest how the energy gained could be used, for example in growth, reproduction or to make enzymes. There were vague answers about breaking down sewage rather than the specific idea of making enzymes.

(d) Candidates found it difficult to explain the advantage of recycling the microorganisms. Here they could have thought of their knowledge of the growth curve as recycling means that it is not necessary to wait for the bacteria to grow and reproduce to give a suitable population to digest the sewage. Few explained that sewage treatment is a continuous process and recycling keeps it that way. The Examiners did not award credit for 'to save time' or 'to use over and over' unless these ideas were qualified. There were answers that mentioned saving money, but no explanation as to how this would occur.

(e) Most candidates knew that chlorine is added in the final stage to kill bacteria. Fewer explained that this prevents the spread of disease and makes water suitable for drinking.

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BIOLOGY

Paper 0610/33
Extended Theory

Key Messages

- Candidates should read questions carefully and not be distracted by trigger words or phrases which they may have encountered in another context.
- Precision in answers is vital. Candidates may well be thinking along the right lines, but responses cannot be credited if insufficiently qualified.
- 'Describe' and 'Explain' are often confused and may be encountered in different sections of the same question. Candidates should be careful not to repeat their description in a section that asks for an explanation.
- Candidates should be instructed to use appropriate scientific terminology. For example, antibodies do not kill diseases; rather they limit the spread of the causal pathogens. Bacteria and/or viruses should be used and not 'germs'.
- Where required in a question candidates should make full and accurate use of the data provided.
- Candidates should always take care to use the correct spelling for names of structures or functions; the Examiners will always reward phonetic spellings so long as there is no confusion with another term that candidates should know from the syllabus.

General Comments

The questions in this paper were drawn from a range of syllabus topics from the Core but with the extra supplemental bias required in the extended scheme. This allowed for slightly more taxing questions or familiar concepts in novel scenarios as well as the more straightforward demands of some questions. For example antagonistic muscle action is usually associated with the biceps/triceps model but in **Question 2(c)** candidates were expected to apply the principle to the muscles in the iris. Some excellent scripts were seen in which candidates demonstrated an impressive knowledge of the material as well as careful consideration of the questions and therefore showed the ability to apply that information successfully. There were some candidates who would have fared better on Paper 2 rather than the Extended Paper. Care should be taken when selecting the most appropriate route for candidates.

All questions were attempted and there were relatively few blanks except in some low scoring scripts. Virtually all candidates answered through to the last question. The presentation and legibility of the scripts was generally very high and very few found it necessary to continue their answers outside of the allotted space. The standard of English expression was often good although there was continued use of non–scientific vocabulary. It was encouraging to note, however that the concept of water potential (**Question 4**) was used correctly across the ability range and that enzymes were denatured and not 'killed' (**Question 3(c)**). It was evident from many middle and low scoring scripts that questions were not read with sufficient care on occasions and candidates did not match their background knowledge to the specific demands of the question. The **Key Messages** (above) are particularly pertinent here. There were instances where information provided in the question was not used effectively. **Question 3(d)** specifically instructed candidates to refer to Fig. 3.2 where, on careful examination, the answers could be found. Extracting data from graphs was generally done well in **Questions 4(b)(i)** and **4(c)**, although effective use of all the information was less evident in the data table in **Question 5(a)**.

Candidates performed well on the following questions: **1(c)**, **2(a)(iii)**, **3(e)**, **4(a)**, **4(b)**, **4(c)** and to a slightly lesser extent the whole of **Question 6**. The genetics diagram in **Question 5(c)** was frequently completed

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well across the candidate range. The more demanding questions were: **1(b)**, **2(c)**, **2(d)(ii)**, **3(b)**, **4(b)(ii)** and **5(e)**.

Detailed comments on candidate performance and strengths and weaknesses per question can be found below.

Comments on Specific Questions

Question 1

(a) The structure of HIV was generally well known; candidates were able to identify the protein coat for **A** and suggested a specific nucleic acid for **B** (DNA was permitted here). Some labelled the structures using terms from eukaryotic cells or bacterial cells; some candidates used the correct term 'capsid' for **A**.

(b) Many candidates gained partial credit for associating destruction of lymphocytes with lack of antibodies, but did not progress to discuss how this caused increased susceptibility to other pathogens. A common idea was that antibodies 'killed disease' rather than stopping the spread (or killing) the causal agents. Good answers included detail of antibody action in clumping or attaching to antigens with occasional additional reference to the subsequent role of phagocytes. The action of some lymphocytes in killing virally-infected cells in cellular immunity was not known. Only a few candidates confused antibodies with antigens or antibiotics although many simply restated the question stem and could not be credited.

(c) HIV transmission via (unprotected) sexual intercourse was well known but there was often a lack of precision in answers that suggested other means. 'Blood contact' is vague unless it is clear that mixing or blood to blood contact could happen. Similarly using 'dirty' needles did not score unless qualified. Several candidates thought that the virus could be passed on in saliva or that it was inherited. Transmission via the placenta or in breast milk was correctly recognised as possible routes.

(d) Examples of all the correct responses from the mark scheme were seen, although many simply restated their answers from **(c)** without actually describing preventative measures. The use of a condom was frequently given; the Examiners did not give credit if candidates gave the answer 'contraception' without stating that a condom should be used.

Question 2

(a)

(i) This was generally answered correctly. A common error was to confuse the pupil with the iris although it was permissible to refer to the iris getting wider under bright light conditions as an alternative to a decrease in pupil size. Ciliary rather than circular muscles were often given; a mistake repeated in other parts of this question.

(ii) It was recognised that contracting the pupil was a response to excess light, although the specific possibility of damage to the retina was often missed in favour of the more general and unqualified 'damage to the eye'.

(iii) The functions of rods and cones were well known with the better descriptions reserved for the latter. Confusion between the two was relatively rare.

(b) Fig. 2.2 was an unfamiliar view of the eye and many candidates interpreted the diagram successfully to label the direction of impulses correctly. A common mistake was to miss out one of the neurones rather than reverse the direction of the impulses.

(c) Only the more able candidates gained full credit here. Muscles were described as working together rather than in opposition. The concept of one muscle contracting while the other relaxed was well known, but this was not always applied correctly to the iris for further credit to be awarded. Some thought that the whole iris acted as a single muscle and there was confusion between the action of circular and ciliary muscles. The suspensory ligament was also mentioned by some candidates. Some also confused antagonistic with involuntary and described the reflex nature of the response.

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(d)

(i) The secretion of adrenaline in 'fight and flight' situations was frequently given as well as some interesting examples of dangerous scenarios. The exam experience was also cited, but some did not qualify their examples for further credit.

(ii) Many candidates knew that hormones have a longer lasting effect, but the idea of simultaneous stimulation of several target organs was only occasionally given. A considerable number thought that hormones elicited a faster response time than neurones.

Question 3

(a) This question was generally answered well. Candidates gave a number of reasons for the stationary phase, even if they did not always use the specific term 'limiting factors'. There was evidence that some did not read the question stem carefully and included temperature as a factor. Others concentrated on defining the stationary phase as death rate = birth rate, rather than explaining the reasons for it.

(b) This was a good question for discriminating between the candidates. Better answers included detail, for example that air added to the fermenter provided the oxygen for *aerobic* respiration together with an appropriate use for the energy released. The basic chemistry of ammonia was often confused. While it was recognised that ammonia was needed for protein synthesis, many thought that it provided nitrate and some suggested that nitrogen from the air was a good source for the process. The role of ammonia in maintaining pH was given occasionally, but the mixing effect of adding the gases rarely so.

(c) Most candidates were able to gain credit here as the theory of enzyme activity was well known, though there was a lack of precision in some answers. Denaturing was not always just linked to high temperatures. Differences in enzyme activity due to temperature variation were not related to what could subsequently happen to the fungus. There was an occasional correct reference to substrate–enzyme collisions; only a very few realised that respiration in the fungus would generate heat. It was encouraging to note that the phrase 'killing enzymes' only appeared rarely.

(d) The question specifically required candidates to refer to information shown in the diagram and this instruction was highlighted in bold. In spite of this, many vague answers were seen on the theme of keeping things optimal to ensure exponential growth. A typical example was to state that temperature should be kept constant without reference to the heat exchanger included in Fig. 3.2. Good answers stated that nutrients were continuously supplied and waste removed. Candidates also stated that the fungus is also continually removed; mycoprotein is not removed, it is not produced until after downstream processing.

(e) This was well known with most gaining full credit. The use of additives as preservatives was the most common response.

Question 4

Some parts of this question on water and ion uptake in plants proved quite taxing, often because candidates did not distinguish between 'explain' and 'describe' in the questions. In other sections, candidates demonstrated their knowledge effectively and interpreted successfully an unfamiliar style of data presentation.

(a) The absorption of water by roots was generally well known and many candidates gained full credit, often by noting the presence of root hairs, their large surface area and the entry of water by osmosis. Many answered in terms of the relative concentrations of water in the soil and root and there was also accurate use of water potential explanations across the ability range. Some thought that active transport was involved in water absorption, either instead of or in addition to osmosis. The importance of reading the question carefully was illustrated by some who went on to describe the subsequent transpiration stream.

(b)

(i) The information from the graph was generally described very well. Good answers included a statement of the general trend, zero growth at 600 units of sodium chloride and one other accurate set of values from the graph.

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(ii) Many candidates could not explain the results and simply repeated their description answers from **(i)**. Although full credit was rarely awarded the question discriminated well. Many candidates across the ability range realised that water could be lost from the plants in solution with high concentration of salt, but relatively few went on to suggest the consequences of this in terms of loss of turgidity, less photosynthesis and transport.

(c) The majority of candidates interpreted the graph and correctly named phosphate and iron. The most common error was to substitute magnesium for phosphate.

(d) This section was answered well by all candidates, especially with respect to magnesium. There was the occasional tendency to describe the positive effects of magnesium without reference to the deficiency. For example, 'magnesium is needed for chlorophyll which makes the leaf green and is needed for photosynthesis' forces the Examiner into making inferences on the candidate's behalf in order to mark the question.

Question 5

This proved to be the most difficult question on the paper. Candidates did not use the data effectively in **(a)** and misinterpreted the question stem in **(e)**. However, many candidates across the range gained credit in the genetics question in **(c)**.

(a) Most candidates gained partial credit for detailing the survival extremes and conditions for the two species. Wet conditions led to 100 % survival for *Tribolium castaneum* in **A** and dry to 100 % survival for *T. confusum* in **F**. Those who continued past these two points usually attempted to consider both species and both environmental parameters at the same time. This often resulted in writing the table out with no real comparison or analysis and there was only a limited appreciation of the effect of temperature. Only a very few candidates separated the data and compared for example **A** with **B** for *T. castaneum* (both hot, but wet in **A** and dry in **B**) giving very different survival rates. Similar comparable data could have been found for the other beetle.

Some candidates made the point that there was decreasing survival with decreasing temperature in wet conditions for *T. castaneum*, but did not note that the converse was true for *T. confusum,* also in the wet.

(b) Many candidates were penalised by poor expression here, reiterating data from the previous section without suggesting clearly any reasons for the results. The idea of competition and adaptation were expected, illustrated by suitable examples such as superior feeding or reproductive rates.

(c) There were many good answers here and the general concepts of genetics were demonstrated well by the majority of candidates, even by those who were not as successful on the rest of the paper. Common mistakes included confusion between phenotype and genotype and the use of inappropriate symbols, even though these were given in the question.

(d) All the points on the mark scheme were seen, but often only one valid point was made on each script. Mutation was frequently given, but not that this in itself is a rare event. The recessive nature of the white eye condition was recognised, but not awarded credit if attributed to a gene instead of to an allele.

(e) This was the most poorly answered question on the paper. The vast majority of candidates across all abilities misread the question stem. The words nitrogenous waste, bacteria and fungi triggered a detailed account of the nitrogen cycle including denitrification and fixation and the subsequent release of nitrate ions for plant growth. Most candidates did not consider that the beetle waste would contain protein or carbohydrate materials and that the whole process was occurring in flour rather than soil. There was occasional mention of decomposition, but not always linked to the bacteria and fungi which were thought to appear later. Good answers referred to enzyme release or digestion by the microbes causing decomposition and the subsequent deamination of amino acids to release ammonia. Weaker candidates also concentrated on the effect on the flour and how it had been rendered unsafe to eat or sell.

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Question 6

(a) Most candidates gained credit by identifying the genus name of the Calayan rail. Those who were not awarded credit either put the species name or put both names. 'Bird' was also seen on several occasions.

(b) Many candidates provided three valid reasons for deforestation including land clearance for housing and agriculture and some use for the timber from the trees cut down. 'Timber' on its own was not credited nor were references to global warming, forest fires, etc.

(c) Loss of habitat and depletion of food source were the commonest responses. The majority of candidates got no further than stating that these effects would lead to extinction but without qualification and without providing more examples. Answers that received full credit here also included reference to a lack of nesting sites and therefore a decrease in reproduction. A lack of precision was frequently seen in this question. *G. calayanensis* was also thought to nest in trees despite being a flightless bird. The possible converse scenario of an increase in the bird population (due to lack of predators, more food, etc.) was not considered by the candidates.

(d) Conservation of food chains and maintaining biodiversity were often given as important reasons to conserve species. Good answers also included reference to maintaining the gene pool and the potential use in medical research.

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BIOLOGY

Paper 0610/04
Coursework

Key messages

This component is designed to test a candidate's familiarity with the practical aspects of biology. Thorough guidance on this is given in the syllabus. It is essential that Centres give candidates an appropriate amount of guidance and that records of the marking of each skill are detailed and easy to follow for moderation purposes.

General comments

Centres are reminded that teachers may not enter candidates for this Paper until they have been accredited. Accreditation can be gained using the distance training materials obtainable from Cambridge. These materials give teachers thorough guidance in the skills that are to be assessed, how to devise suitable tasks for assessments, how to mark their candidates' work, and how to organise and submit their coursework sample for external moderation.

The syllabus provides descriptors of what a candidate must be able to do to achieve a mark of 2, 4 or 6 within each skill. Teachers are asked to write specific mark schemes for each assessment task. The mark scheme should address each point within the descriptors, and be specific to the particular task being undertaken. Most Centres do this well, but in a few cases in this examination session the mark schemes missed out important parts of the descriptor, and in some cases a mark scheme for one skill contained points that belonged with another skill. It is very important that a mark scheme for one skill includes all components of the descriptor for that skill, and that it does not contain any components that belong with a different skill.

Skill C1 involves the candidate's ability to handle apparatus and carry out practical techniques. Most teachers assess performance on this skill using a set of points organised into a check list. Each check point is related to a particular level within that skill, and candidates are scored according to the levels of the check points they achieve. Centres are expected to provide evidence to support the marks that they have awarded, but of course there is no written evidence that they can submit. It is therefore important to send in the completed check lists, so that the external Moderators can see what each candidate did within the C1 assessment task. A few Centres did not do so, which makes it impossible for the marks to be moderated.

Skill C2 involves making observations and recording observations and measurements. In biology, some observations may be recorded in the form of diagrams, and most Centres include one such task. Observations and measurements can also be recorded in tables. Tasks should be chosen that provide sufficient opportunity for candidates to reach Level 6. Very simple tasks, in which perhaps only three or four readings have to be recorded, are unlikely to allow a candidate to be awarded a mark above 4. Similarly, care must be taken not to give too much guidance on the worksheet, as this can also limit the maximum mark awarded.

Skill C3 involves interpreting and evaluating experimental observations and data. All Centres now appreciate that this must be done within a practical context; it is not suitable to provide candidates with a worksheet using results that they have not collected themselves, although it is possible to use results collected during a demonstration in which they have been involved. This skill really needs to be assessed through a task that involves numerical results, preferably ones that can be displayed as a graph. Once again, guidance must be limited if candidates are to reach Level 6. A few Centres provided candidates with graph axes, which effectively limits their mark on the graphing component of this skill to a maximum of 4.

For Level 6 in Skill C3, candidates must be able to recognise and comment on possible sources of error. Candidates from some Centres did this particularly well this year, and it is good to see a continuing improvement in this high level skill. However, in some Centres there is confusion between human mistakes (such as not reading the scale on a thermometer correctly) and genuine experimental error (such as the impossibility of keeping a particular variable constant). Teachers must ensure that they and their candidates

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understand the concept of experimental error, and that their worksheets encourage candidates to think about these when they are being assessed for Skill C3.

Skill C4 involves planning, carrying out and evaluating an investigation. Some Centres made this difficult for their candidates by not providing a clear-cut task for them. For example 'investigating amylase' does not lead candidates in to planning a suitable experiment. 'Investigating the effect of temperature on the rate of activity of amylase' is a far better starting point. There is no need for candidates to think up their own question or hypothesis, although of course some Centres may wish them to do this.

The C4 task should involve the investigation of the effect of one variable on another. Candidates should be encouraged to use the term 'variable' in their report, and to state clearly which variable they are changing, which variable they are measuring, and which variables they are trying to keep constant. This was not always the case in the samples this year. If a task is set that does not require the control of variables – for example, the identification of substances such as sugar, starch or protein in a solution – then it is not possible for candidates to reach beyond a Level 2.

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BIOLOGY

Paper 0610/51
Practical Test

Key Messages

To do well in this examination candidates had to report their results accurately and draw conclusions from their own results. If a result was not what was expected candidates should have said so, and suggested an explanation if they could.

Candidates would benefit from practice in saying exactly what they mean. For example if they suggest that an experiment should be repeated, they should say how many times and what variables would be kept the same.

General Comments

Most candidates completed the two questions. Some showed signs of hurrying through **Question 2(b)** and parts of questions were sometimes left out. Where credit was not awarded, this was often through difficulties with articulation rather than lack of understanding of the biology. Many candidates had a greater knowledge of feather structure than would be expected at this level.

Supervisors sent reports of their candidates' work. It was useful for the Examiners to know of any difficulties. Not all Supervisors reported what kind of feathers were provided for **Question 2(b)**. It is important for Supervisors to give full details in this report.

Comments on Specific Questions

Question 1

Candidates were asked to perform an experiment in which a measured cube of sweet potato was covered with a pre-measured volume of hydrogen peroxide and the bung replaced on the apparatus. After repeating this test the candidates went on to cut the same sized cube into eight small pieces and do the test again.

Almost all candidates were able to do this experiment. The confidential instructions asked that the hydrogen peroxide solution was freshly diluted to avoid a vigorous reaction before the bung was replaced. Candidates were expected to count the bubbles coming out from the open ended delivery tube in one minute in tube **B** and measure the depth of the foam in tube **A** after a further minute. Most candidates did this and wrote their results in Table 1.1.

(a) Some candidates probably did not make sure that the delivery tube was under the water in tube **B**, and did not see many or even any bubbles. They did have foam produced in tube **A** and were able to measure it showing that the reaction was active.

Some must have measured the depth of foam in centimetres although the table heading was in mm. Units should not be written in every box in a table. Some candidates would be helped with a little revision of units for measuring. Then they would know that a length of 2500 mm would not fit in a test tube and that standard rulers cannot measure to 0.1 mm.

When describing the quantity of a substance used, the same volume of a solution of the same concentration is more precise than describing it as the "same amount".

(b) Candidates are obviously used to repeating experiments and taking averages of their results. A second trial is also useful to test a method. If the same procedure is followed twice, the result should be the same or very similar. In this experiment it might be impossible to replace the bung

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and start counting bubbles the first time if the reaction was very vigorous. The candidate would be better prepared on the second attempt.

(c)

(i) This question asked candidates to use their experimental data to compare the activity of the enzyme catalase in the cut up cube with cube 2 which was left whole. Answers that the reaction with the cut up cube was more active or more vigorous, produced more bubbles or greater depth of foam were all good. Some candidates were tempted to go on to explain why. The explanation was the answer to the next question. Candidates should be reminded to read through the whole paper before they begin. Sometimes candidates incorrectly compared the activity of the first two cubes instead of cube 2 with the cut up cube.

(ii) In the explanation it was essential for candidates to remember that the enzyme in the experiment was in the sweet potato. The substrate for this enzyme was the hydrogen peroxide which was added to the sweet potato in tube **A**. Cutting the cube of sweet potato into eight small pieces released more of the enzyme to the hydrogen peroxide. Quite a lot of candidates wrote about the reaction as if it were an enzyme in the solution which acted upon the sweet potato tissue. They realised that there was a greater surface area of sweet potato tissue in the cut up cube but not that there was more contact between the enzyme in the tissue and hydrogen peroxide the substrate. Cutting the cube into smaller pieces also exposes freshly cut cells to the substrate.

(d) This question asked for likely sources of error on the design of the experiment. One difficulty was in putting the sweet potato and the hydrogen peroxide into tube **A** and replacing the bung quickly. Taking longer on one occasion would mean that oxygen would escape and therefore the number of bubbles counted would be fewer. The result would be a smaller number of bubbles than it should be. Many candidates recognised this difficulty but did not explain the effect on the number of bubbles. Some said that the result would be inaccurate but not in what way.

Many candidates went on to describe how the error could be overcome instead of the effect the error would have on the result. A few candidates used this question as a chance to criticise the apparatus rather than the design of the experiment. They complained that they did not have enough test-tubes or the hydrogen peroxide was too dilute. Candidates must be more critical on experimental design.

(e) Candidates were asked to draw the apparatus. The candidates had to have a clear mental picture of the apparatus they would use to collect more reliable data. The best diagrams were drawn with ruled lines and labelled.

Good candidates knew that this experiment was sensitive to temperature change. The volume of oxygen would be increased by a rise in temperature. The reaction was exothermic but almost no candidates commented that the tube got hot. Some planned to use a water bath to keep the temperature the same all the way through. Just adding a thermometer would not have been enough. The experimenter would only know that the procedure had been unreliable. A few candidates mentioned that the enzyme would be denatured if the solution was too hot.

Collecting the oxygen in a measuring cylinder by downward displacement of water, or with a gas syringe and recording the volume of gas released would avoid counting bubbles. The bubbles were produced fast and varied in size so were hard to count accurately. Using a graduated test tube for the reaction would make measuring the depth of foam easier and more accurate than holding a ruler beside the tube which would be difficult to keep in place.

Some candidates suggested adding the hydrogen peroxide solution through the bung with a syringe. This would avoid removing the bung and losing oxygen.

Repeating the experiment a stated number of times with whole cubes, and then a stated number of times with the cut up cubes was a valid suggestion. Not many candidates said they would calculate the mean for each although some remembered that the variables would have to be kept the same for all the tests.

Use of stop watches or automatic timing devices and computerised monitoring systems were occasionally suggested. Having a better view and hands free by means of using support apparatus were other good answers.

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Despite all these ideas, few candidates were awarded full credit for this section. They were content to describe only one or two improvements but not how or why these needed to be implemented even though the section carried 5 marks.

Question 2

Candidates were required to compare the rate of cooling of water in three test tubes. One test-tube was covered by a single sheet of tissue paper, one with aluminium foil and the third remained uncovered over a set period of time.

(a)

(i) This section which asked for the construction of a table, was usually well done. The tables were mostly ruled, had the units in the headings and were in an appropriate orientation. (The independent variables were in the columns and the dependant variables were the rows.)

(ii) Most candidates completed their tables with the temperatures, minute by minute, of the water in the three test tubes.

(iii) There were some neat, clear line graphs. The best graphs were drawn with the time in minutes along *x*-axis as the controlled variable and the temperature in °C on the *y*-axis as the dependant variable. Candidates need to be reminded that they do not always have to start the axes at zero. The graphs should fill at least half of the printed grid and more if possible. If the scale is large, candidates can more easily draw the points accurately. It is also easier for someone to see the results and that the points are plotted correctly. The difference in the rate of cooling in the three tubes is less obvious if there is only half a square for each °C.

This graph needed a key to show the lines for the different experiments. This could have been by using different symbols for the points. The best method to use would have been symbols such as + signs, x signs or dots in circles so that the points could still be identified if the lines crossed the points. Some candidates used coloured lines. Many candidates did not make a key.

Candidates should have known that something was wrong if the temperature rose for the first two readings. The temperature of the water could only fall as the water cooled.

(iv) It was hard for some candidates to describe what had happened to the temperature of the water in the three tubes. All the water cooled down but at different rates in the three tubes. Ideally all three tubes should have had water at the same temperature at the start. Candidates should have noticed the temperature at the beginning. A lot of candidates took notice of the final temperatures and compared the three tubes but did not make any allowance for a tube containing cooler water at the start. Instead they made statements referring to 'one tube always being hotter than the others'. It was expected that the fall in temperature calculated by subtracting the final temperature from the initial temperature, would be given to account for any difference in the starting temperature.

Few candidates used the word "insulation" but many were able to describe that paper and foil prevented some heat from leaving the tubes.

A few candidates reported that water in the paper covered tube had lost heat quicker than the water in the unwrapped tube. Some of them realised that the explanation for this was that the paper had got wet and that evaporation of the water on the outside of the tube increased cooling of the water inside.

(b)

(i) The feather drawings showed that a wide range of different feathers were supplied. The question asked for an outline drawing which is an instruction to leave out all shading; some candidates ignored this and shaded their drawings. Shading is not appropriate for biological drawings such as this. The drawings ranged in size from minute to large clear drawings showing details of the structure and where the feather had been attached to the bird.

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Candidates should use most of the space provided. Some drawings were in ink. Candidates should be reminded to use well sharpened HB pencils and reliable erasers.

Although the names of feather parts are not on the syllabus, many candidates were familiar with them.

(ii) Almost all candidates recognised that the downy feathers helped birds to maintain their body temperatures and many understood that the structure of flight feathers resisted the air and made flight possible. Some had difficulty in expressing these ideas.

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BIOLOGY

Paper 0610/52
Practical Test

Key Messages

Candidatesa re advised to read every question carefully and to look at the command terms used at the start of each question. The list of command terms and definitions can be found in the 0610 syllabus in the 'Glossary of terms used in science papers' section.

General Comments

The presentation of answers showed understanding of the questions. Some candidates had difficulty with the language and spelling of specific terms e.g. radicle. The drawings were often well presented but some were not labelled. Candidates do need to use clear outlines without shading and to use an HB pencil. Many candidates presented accurate line graphs in **Question 2(d)(iii)** though the choice for the scale was frequently inaccurate.

There were examples in all questions where candidates did not read the question carefully.

Comments on Specific Questions

Question 1

The topics covered in this question were based on the formation of seeds in the fruit of a plant belonging to the *Cucurbitaceae* family, the structure of a seed and the conditions required for germination of these seeds.

(a) Candidates were asked to make a large, labelled drawing of the fruit provided. The type of fruit provided differed based on the availability of such fruit for Centres and included cucumber, melon (various types), pumpkin, marrow, and squash. Sometimes a whole slice was provided and for other candidates only a thin portion of slice with a few seeds attached.

It was hoped that the drawing would be large to fill at least half of the 20 cm space provided in the examination paper. The two points outlined in the question indicated that the arrangement of the seeds and the thickness of the fruit wall should be shown in the drawing. A clear outline was required and no part of the drawing should be shaded.

From the drawings seen, many candidates showed an excellent ability to accurately draw the shape of the fruit provided and to represent the arrangement of the seeds accurately. These observation skills are to be commended. Many Supervisors sent photographs of the fruit provided attached to their report.

Many drawings were unfortunately not labelled or only by the two drawing requirements stated in the question.

(b) Candidates were required to remove a seed from the fruit and to describe the external appearance of this seed. The shape of the seed, the ridged edge, the colour or texture were points that were described and many candidates were able to record two of these points. Some Centres provided candidates with mature seeds from a different fruit than that provided for **(a)** and when this was the case, some candidates described the soft, sticky immature seeds.

(c)

(i) Candidates described how they would carry out of food tests for fat and starch on the internal stored materials in the seeds correctly. The preparation of the tissue for these tests was described clearly in the question.

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For the fat test, most candidates described the emulsion test that is sensitive to indicate the presence of lower quantities. A common error was to mention the use of water before dissolving the fat in a suitable solvent. This would not lead to the formation of a cloudy or white emulsion. A few candidates described the 'grease-spot' test that is used when there are substantial quantities of fat present. Other candidates described the Sudan III test which is usually carried out on sections to show the presence of fat in cells and can then be observed with the aid of a microscope.

For the starch test, the common error was to add 'iodine' not 'iodine solution' or 'drops of iodine'. It should be explained that iodine itself as an element, is a solid and will not react with starch unless it is dissolved in potassium iodide solution.

(ii) Candidates then carried out these tests on the prepared chopped or crushed tissue. A table was printed for candidates to record the observed colour changes and to give the conclusions.

For the fat test, some candidates recorded the presence of fat in the seeds. In the immature seeds no fat was observed.

For the starch test, most candidates recorded the initial colour of the iodine solution and then the colour that resulted to show the presence of starch in the seeds. In the immature seeds this expected colour change did not occur.

(d)

(i) Candidates were required to label a diagram of a seedling. Although the names for the parts of developing seedlings are stated in the syllabus, many candidates were unable to use these terms correctly. This question was often left unanswered. The most common label given was for the obvious root hairs and not the cotyledon, plumule or the radicle.

(ii) The requirements for germinating seeds are outlined in the syllabus and most candidates correctly described the three environmental conditions and named a suitable medium for use either in a laboratory or in the outside environment. All the necessary materials for the initial growth are stored in the seed so there was no need for fertilisers or light at this stage. Some candidates specified a temperature by giving that of the human body but this was not necessary. Some seeds require extremes of temperature to break dormancy but this level of detail was not required. Later stages of seedling development would require light for photosynthesis but not for germination of these seeds.

Question 2

The basis for this question was the osmotic changes in chip- like sections of Irish potato.

(a)

(i) Candidates were required to measure the length of the potato 'chip' that measured exactly 60 mm in length originally, that had been submerged for several hours in a concentrated salt solution. This measurement was intended to be recorded with the units used, especially if different to the mm given in the introduction to the question. Many candidates completed this task correctly. Some of the measurements were given in centimetres. This was acceptable if the change of unit was given but these measurements were incorrect by a factor of 10, if this change was not given. The change in length after three hours recorded for the 'chip' in salt solution, required the use of the sign (-) or the words 'decreased by' before the actual figure for the difference.

(ii) The candidate was required to describe the appearance and texture of the 'chip' that had been soaked in a concentrated salt solution. The 'chip' was soft, flexible and would bend easily when picked up with forceps. Similarly, there was often a different colour recorded and the surface appeared rough or wrinkled.

(b)

(i) The second potato 'chip' soaked in distilled water also needed to be measured by candidates and the change in length recorded. Similar problems involving units for the measurements were encountered.

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(ii) The appearance and texture of the 'chip' which had been submerged in distilled water was different to the previous one. The 'chip' was hard and inflexible and had a smooth surface.

Most candidates answered the last four parts well.

(c) This question required an explanation for the measurements and changes in appearance and texture in the potato 'chips'. Many candidates realised that osmosis was involved and defined the process and then continued to explain the changes with a decrease in length of the 'chip' submerged in concentrated salt solution and an increase in length for the 'chip' submerged in distilled water. Although the direction of flow of water out of and into the 'chips' was explained, the direction of the gradient was not always clearly expressed. It is the cell membrane that is the partially permeable structure that allows the passage of water by osmosis.

Common errors for less able candidates included description of the changes recorded and not an explanation. Muddled ideas of salt movement and active transport were seen.

(d) The results for an investigation involving changes in mass were given in a table for candidates to handle a set of data in this part of the question.

(i) Candidates were required to calculate the percentage change in mass of the 'chip' in the most concentrated sucrose solution. Most candidates showed good mathematical skills to complete this calculation and many showed the working in the space provided. Those candidates who were unable to calculate this percentage often then did not continue to plot the graph in **(iii)**.

(ii) The table recorded the mass of the 'chip' at the start in grams and these values differed for the different 'chips'. The only way to compare the changes at the end after the two hours, was to calculate the percentage change. Only some of the able candidates realised this point by looking back to the data given. Many candidates gave general answers referring to reliability or accuracy but not explaining why the percentage was calculated.

(iii) A line graph should be used to plot the two continuous sets of data, the percentage change in mass against the concentration of the sucrose solution. Most candidates did use a line graph to present this data, only a few bar charts were noted. The axes orientation was given but the scaling of both of these axes gave problems to candidates. The *y*-axis needed to be scaled to show the increase in mass above the *x*-axis and the decrease in mass below this horizontal with a negative sign to distinguish the two types of percentage change. The concentration of sucrose solution in g dm^3 needed to range from 0 to 270 g dm^3 with the intermediate values spaced evenly across the whole range and not the five values given in the table spaced at equal intervals. Candidates carried out plotting the points accurately. Most plotted points were neatly shown though there is a tendency to make 'dots' or 'crosses' too large. The points were generally joined by means of ruled lines that need to pass through each of the plotted points and to be constructed with thin lines (not thick lines that obscure the plotted points). The line should finish at the last plotted point and not be extrapolated beyond this.

Weaker candidates especially those who did not calculate the percentage change in mass for **(d)(i)** did not attempt to plot the graph.

(e)

(i) Recording the concentration of sucrose solution in which the mass of the 'chip' would stay the same, required reading the value from the graph where the line crossed the *x*-axis. The candidates that plotted the graph were able to read off this value correctly. It was unfortunate that some of these candidates recorded values beyond this value at a far higher sucrose concentration.

(ii) The explanation required candidates to compare the water moving into the 'chip' with that leaving the 'chip' so there was a balance, resulting in 'no net movement of water'. Osmosis will not stop as the cell membranes are partially permeable. Able candidates used this terminology or an alternative to express the idea of equality in many different ways. Weaker candidates repeated the wording of the question and did not explain the reason.

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BIOLOGY

Paper 0610/53
Practical Test

Key Messages

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Most candidates answered the last four parts well.

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Common errors for less able candidates included description of the changes recorded and not an explanation. Muddled ideas of salt movement and active transport were seen.

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Candidates carried out plotting the points accurately. Most plotted points were neatly shown though there is a tendency to make 'dots' or 'crosses' too large. The points were generally joined by means of ruled lines that needed to pass through each of the plotted points and to be constructed with thin lines (not thick lines that obscure the plotted points). The line should finish at the last plotted point and not be extrapolated beyond this.

Weaker candidates, especially those who did not calculate the percentage change in mass for **(d)(i),** did not attempt to plot the graph.

(e)

(i) Recording the concentration of sucrose solution in which the mass of the 'chip' would stay the same, required reading the value from the graph where the line crossed the *x*-axis. The candidates that plotted the graph were able to read off this value correctly. It was unfortunate that some of these candidates recorded values beyond this value at a far higher sucrose concentration.

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BIOLOGY

Paper 0610/61
Alternative to Practical

Key Messages

Candidates should be familiar with practical procedures and capable of planning and modifying simple investigations.

In **Question 1** they need to be able to handle experimental data appropriately and choose the most suitable method of presenting results.

Questions 2 and **3** require careful observational skills. These observations would enable candidates to make an accurate diagrammatic representation of a specimen, successfully record and interpret experimental results and identify similarities and differences in the given specimens.

General Comments

The standard of English was good and the presentation of answers showed a reasonable understanding of the questions. Candidates attempted all questions and most showed that they had adequate time to finish the paper.

It is important that candidates read through questions carefully to understand what is required in their answers.

In **Question 1(c)** candidates were asked to make suggestions and explain how to plan a similar investigation to the one described in the question in order to improve reliability. However, too many chose to describe completely different experiments. Others made suggestions but did not explain the necessary practical procedure to carry them out. Candidates need more guidance in planning investigations and this would result in an improvement in the performance of candidates of all abilities

In **Question 2(a)(i)** candidates' outline diagrams were generally good but they were asked to label them and the majority did not attempt any labels.

Comments on Specific Questions

Question 1

This question was based on an experiment to compare the catalase activity of the enzyme found in in two plant tissues, sweet potato and Irish potato, by collecting and measuring the volumes of oxygen gas given off. Candidates had to calculate total and mean values of oxygen released for Irish potato. They also had to present the four experimental results for the sweet potato in a bar chart and draw in a line to show the mean. The candidates were asked to suggest reasons for the variation in results and plan a similar investigation to collect more reliable data.

(a)

(i) Most candidates gained full credit for correctly calculating the total and mean volumes of oxygen gas produced by the Irish potato. These were successfully recorded in the table.

(ii) Many candidates correctly suggested that the tissues were cut into small pieces to allow the reaction to proceed faster or to increase the surface area. A small number of candidates realised that more catalase or enzyme would be released. The most common suggestion, that was not accepted, was to state that small pieces of potato could fit into the flask more

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easily. A common error was to state that small pieces would allow the potato to dissolve more easily. The tissue did disintegrate but did not dissolve.

(b)

(i) In this question candidates were asked to draw a bar chart to show the volumes of oxygen gas collected for the sweet potato. The bar chart was asked for because the four experiments were discrete categories and the volume of oxygen gas was a numerical dependent variable. A number of candidates incorrectly presented the data as histograms or line graphs. Histograms show the variation in a sample of repeated measurements separated into classes or groups. Line graphs are used when both variables are continuous with interval data.

The experiment number should be shown as the label for the *x*-axis and the volume of oxygen gas on the *y*-axis. Most candidates correctly orientated their graph and labelled the axes appropriately. The number of the experiment should be centrally placed under each column and the *y*-axis should be labelled with volume of oxygen or gas accompanied by the correct units as volume of oxygen / cm^3.

The axes should be evenly spaced so that the columns plotted make full use of the grid. Candidates were required to use more than half of the available grid to scale their graph. This was well achieved by most of the candidates using 1 small square to 1 cm^3 as the scale on the *y*-axis. The majority of the candidates plotted the columns accurately, very few errors were seen.

The columns should be of equal width with an equal space between the columns. Many candidates incorrectly drew columns which touched as in a histogram. Most columns were neatly drawn with a ruler. A small number of vertical line graphs were drawn. Shading of the columns was unnecessary but frequently seen.

Candidates were also required to draw a horizontal line across their bar chart to show the mean value. Most candidates who drew this line did so correctly but a large number did not draw a line at all. A small number of candidates either, incorrectly, drew in a line showing the mean value of the Irish potato results or drew the mean value of the sweet potato as a separate column.

(ii) This part of the question asked candidates to suggest two reasons for the variation in the four sweet potato experimental results. More able candidates realised that the volume and / or concentration of catalase released may have varied and was dependent upon the type, age or part of the sweet potato tuber used. The most common correct suggestions were differences in temperature and / or pH. Many identified differences in surface area, sometimes described in terms of number or size of potato pieces used. The difficulty of gas escaping through the bung when the hydrogen peroxide was added was also seen.

Incorrect suggestions, frequently seen, included different sizes of sweet potato, instead of sweet potato pieces used in each experiment, different volumes or concentrations of hydrogen peroxide or variable periods of time during the experiment. These were all specified in the question as part of the method so it should be assumed that these quantities would be the same for all four experiments.

(c) Candidates were then asked to suggest and explain two ways in which a similar investigation could be planned to collect more reliable data. Many candidates had already identified two reasons for the variation in the original experimental results in **(b)(ii).** They could have used these ideas to plan improvements to the original method to overcome these differences. This would have resulted in a similar investigation.

Only a small number of the more able candidates gave valid suggestions, often linked to the reasons that they had given in **(b)(ii).** In most cases, although they suggested a correct variable, very few candidates were able to gain credit for an appropriate improvement. For example, they identified that the temperature should be kept constant but did not suggest a way to achieve it e.g. using a thermostatically controlled water bath. The most common correct suggestion and improvement was cutting equal sized potato pieces to keep the surface area constant. Some candidates suggested repeating the experiment but to gain credit for this it had to be clear that it would be done more than four times as given in the original experiment. 'Several times' was too

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vague as it may have meant less than four times. Instead of stating that this would reduce mistakes or remove anomalies, many simply repeated the question and so the candidates did not gain credit for explanation. Many of the possible linked suggestions and explanations given in the mark scheme were seen although not often together in one answer.

Overall, the majority of candidates did not understand the idea of a **similar** investigation and designed completely different experiments in terms of methods and materials used. Different plant or animal tissue was used and there were many changes to the way in which the apparatus was set up, often resulting in a completely different experiment and results. Some of the candidates who had correctly identified differences in temperature or pH as possible reasons for variation in **(b)(ii)** went on to suggest experiments with varying temperatures or pH. A common error was to describe testing the potato for various foods e.g. starch or sugars; these are different investigations.

Question 2

(a)

(i) Candidates were asked to make a labelled outline drawing of feather **A**, the 'down' feather. The majority of the drawings were larger than the photograph. An outline drawing should be a simple line drawing to show the overall shape of the feather and no detail is required. In this drawing, therefore, there was no need to draw the individual barbs. The detail of the fine barbs and their involvement with the overall outline of this feather made it quite a difficult task and credit was given for any reasonable representation of feather **A**. Most candidates made a good attempt but did include many fine details of feather **A**. The majority of candidates' drawings gained full credit for drawing. Drawings should not be shaded.

The drawing had to be labelled however. Although the names for parts of the feather were not on the syllabus and candidates were not expected to know them, a small number of candidates did know some correct names e.g. quill, vane, barb or shaft. Only a small number of candidates made an effort to label their feather and credit was given for simple labels such as 'point of attachment to the bird or body'. The most common errors, for those candidates who did attempt to label the feather, were to use terms specific to plants e.g. stem, root or to label the barbs as hairs or fur. Many candidates made no attempt to label the feather.

(ii) Most candidates made a reasonable suggestion for the function of feather **A.** Common errors were to repeat the question and state that it covers the body or to say it simply protects the bird without any reference to the cold. No credit was given for saying that the feather 'warms the bird'. This is because the feather helps prevent heat loss from the bird and does not itself generate heat.

(iii) Candidates were asked to suggest a function of feather **B** and explain how it is adapted. The majority knew that it was a flight feather. The adaptation was less well known. Good answers described the ability to push the air or its aerodynamic shape. Many candidates, however, only described features of the feather, e.g. light, strong or smooth. Other candidates only commented on the arrangement of the feathers, e.g. 'close together with no gaps between the feathers' or 'the feathers provide an increased surface area' and these candidates did not link these to flying.

(b)

(i) A grid was shown with feather **B** placed on it and candidates were asked to use this grid to help estimate the surface area of feather **B**. The candidates were also asked to measure the size of one of the grid squares. This question was not well answered.

One square on the grid measured 1 cm^2 and credit was given for this. However, the majority of candidates did not state this or annotate the grid, even though they may have worked it out. Common errors were to state 1 cm x 1 cm or to confuse volume for area by using 1 cm^3 instead of 1 cm^2. It was expected that the candidate would attempt to count the number of squares and parts of squares occupied by the feather on the grid and then add them together for the total surface area. A small number of candidates did clearly show that they had used this method. Some marked the squares on the feather, some showed evidence of counting up squares and parts of squares in their working and others did both. Others left the feather and grid blank and relied on estimation. However, the majority of candidates did

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not use this method but counted the number of squares for the length and the number for the width and multiplied them together. Most of these candidates did take account of the quill in a separate calculation and add it to the area of the blade to give the total surface area. This method could have been achieved without the grid using a ruler to measure the length and width of the feather and so was not given credit. It usually gave an estimation which was outside the accepted range.

(ii) Having estimated the surface area of feather **B** using the grid, candidates were then asked to describe a more accurate method to find the actual surface area of the feather. Again, this was not well answered and it was obvious that many candidates had no experience of this kind of task and were unable to work out a method. A small number of candidates were aware of the method by which the feather can be divided into geometric shapes, the separate areas calculated and added together. Others realised that it would be more accurate to use a grid with smaller squares or they had the idea of cutting the feather into smaller pieces to fit the 1 cm^2 squares. The most common error was to confuse perimeter length with surface area and measure around the feather with string. Some candidates described the method of estimation using the grid which was required for **2(b)(i)** or suggested measuring the length and width more accurately and multiplying the two. Volume measurement and the use of magnification were also seen. No credit was given for using a computer programme. A small number of candidates did realise that the total surface area of the feather would be found by multiplying the calculated surface area by two to include the top and bottom surfaces.

Question 3

Candidates were given drawings of three cress seedlings, **D**, **E** and **F**, and for each one were asked to state a difference and suggest an explanation for the growth pattern shown in the diagram. The information given stated that the seedlings came from seeds of the same plant, grown for the same amount of time but under different conditions. This was not always taken into consideration in their answers. A common error was that candidates described all the seedlings and tried to explain their growth without identifying a difference for each one.

(a)

(i) Seedling **D** had grown curved to the left side. The leaves were expanded and showed a normal development. Simply stating that the stem was bent or twisted without a direction was not given credit. Many candidates realised that there must have been light on the left side. More able candidates realised that this was an example of phototropism and there were a number of correct references to auxins. One common error was to state that the seedling had wilted or died through lack of water or nutrients. Some candidates described its growth incorrectly as an example of positive geotropism, stating that the shoot was growing towards gravity. Others suggested that it was bent because it had been blown over by the wind which is quite a good idea for a mature plant but not for a seedling. Difference in root growth was not given credit as it was almost the same as seedling **E**.

(ii) Seedling **E** was less well understood. The seedling had grown very much taller than the others but most candidates assumed that this was an example of good, healthy growth. Healthy or normal growth was not accepted as a valid difference. The information in the stem of the question had stated that the seedlings were grown under different conditions and very few candidates suggested that this very tall and thin seedling had been grown in the dark or amongst other plants where there had been competition for light. Most suggestions described the seedling growing up towards light. Some did state that the light was directly above.

(iii) Seedling **F** had a smaller shoot and root than **D** and **E**. The seedling had grown less and most candidates suggested that this may have been a result of less minerals or a colder temperature. Many candidates gained full credit here. The most common error was to suggest that the poor growth was linked to the plant growing in the dark and being unable to photosynthesise.

(b)

(i) Candidates were given drawings of two types of fruit, **G** and **H**. These are both dehiscent fruits which are dry fruits that split and open. Both fruits are members of the Cruciferae family. Fruit **G** is an example of a silicula, a round fruit, e.g. Honesty, *Lunaria annua,* and

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fruit **H** is an example of a siliqua, a fruit with its length being more than twice its width, e.g. cabbage, *Brassica oleracea*.

Candidates had to describe two similarities and this was generally well answered. Many answers stated that both fruits had seeds contained within them and this was awarded full credit. All of the possible marking points were seen. A few candidates confused ovules with seeds and others did not know or recognise that the small round structures within the fruit were seeds and simply referred to them as white circles or patterns.

(ii) Candidates were asked to record two differences between fruits **G** and **H**. It is important that each row in the table has corresponding or comparative answers on each side. Most correct answers gave differences about shape of the fruit and numbers of seeds. The most common error was to give two similar answers e.g. two which describe the shape of the fruit rather than two distinct differences.

(c) These fruits split open and their seeds fall to the ground or may be shaken by the wind to a short distance from the parent plant. Candidates were asked to suggest how these seeds may be dispersed from the fruits but they did not have to explain their answer. A small number of candidates confused dispersal and pollination.

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Paper 0610/62
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Key Messages

Candidates are advised to read every question carefully and to look at the command terms used at the start of each question. The full list of command terms and definitions can be found in the 0610 syllabus, in the 'Glossary of terms used in science papers' section.

Candidates are advised to use an HB pencil for drawings and to erase all incorrect lines thoroughly with a good rubber.

General Comments

The presentation of answers showed understanding of the questions. Some candidates had difficulty with the language. The drawings were sometimes well presented but some were unlabelled. Candidates do need to use clear outlines and not include shading. Many candidates presented accurate line graphs in **Question 2(b)(iii)**, though the choice for the scale was frequently inaccurate.

There were examples in all questions where candidates did not read the questions carefully.

Comments on Specific Questions

Question 1

The topics covered in this question were based on the formation of seeds in the fruit of the butternut squash, *Cucurbita moschata,* their structure and the conditions required for germination of these seeds.

(a) Candidates were asked to make a large, labelled drawing of the fruit from the photograph. It was expected that the drawing should be the same size or larger than the image and to show the whole fruit. Two points outlined in the question indicated that the arrangement of the seeds and the thickness of the fruit wall should be shown in the drawing.

The majority of candidates showed the fruit in the same view as that in the photograph but a number of candidates rotated the fruit through 90°to draw it vertically. These drawings were always smaller in length than the original.

A clear outline was required and no part of the drawing should be shaded. The shape of the fruit should resemble that of the illustration. From the variation of shapes observed, it is clear that many candidates were able to accurately draw this fruit and represent the arrangement of the seeds. These observation skills are to be commended. At the other end of this ability range – candidates would be advised to use a grid to help with the scale of the various parts to gain correct proportion of the two points specifically required.

Many drawings were not labelled or only by the two drawing requirements stated in the question.

(b) A detailed photograph showed the external appearance of two butternut squash seeds, one in surface view and the other in side view. Candidates were required to describe the appearance of these seeds. The shape of the seed and the ridged edge were points that were visible and many candidates were able to record these points. The ability of candidates to express these ideas clearly varied considerably.

(c) Candidates were required to label a diagram of a germinated butternut squash seedling. Although the names for the parts of developing seedlings are stated in the syllabus, many candidates were

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unable to use these terms correctly. This question was often left unanswered. The most common label given was for the obvious root hairs and not the plumule or the radicle.

(d) Descriptions of food tests for fat and starch found as stored materials in the seeds were correctly given by many candidates. The preparation of the tissue for these tests was described clearly. Although familiar to many candidates, there appears to be a large proportion that had not carried out these food tests individually.

For the fat test, a common error was to add the water before dissolving the fat in a suitable solvent. Several candidates described the grease spot test. This is only applicable if there are substantial quantities of fat present. Other candidates described the Sudan III test which is usually carried out on sections to show cells and observed with the aid of a microscope. For the starch test, the common error was to add 'iodine' not 'iodine solution' or 'drops of iodine'. It should be explained that iodine, itself as an element, is a solid and will not react with starch unless it is dissolved in potassium iodide solution. If candidates are describing a colour change it is good practice to give the initial colour as well as the end colour.

(e) The requirements for germinating seeds, such as these squash seeds, are outlined in the syllabus and most candidates correctly described the three environmental conditions and named a suitable medium for use either in a laboratory or in the outside environment. All the necessary materials for the initial growth are stored in the seed so there was no need for fertilisers or light at this stage. Some candidates specified a temperature by giving that of the human body but this was not necessary. Some seeds require extremes of temperature to break dormancy but this level of detail was not required. Later stages of seedling development would require light for photosynthesis but not for germination of these squash seeds.

Question 2

The basis for this question was the osmotic changes in chip- like sections of Irish potato.

(a)

(i) Candidates were required to measure the lengths of two potato 'chips' from the photographs, each measuring exactly 60 mm in length originally that had been submerged for three hours in either distilled water or a concentrated salt solution. These two measurements were to be recorded in a table that had specified units (mm) and space to record the change from the original 60 mm. Many candidates completed this task correctly but it was disappointing to note that other candidates did not read the question carefully and follow the rubric. Some measurements were given in centimetres. This was acceptable if the change of unit was given but these measurements were incorrect by a factor of 10, if this change was not given. The change in length after three hours recorded for the 'chip' in salt solution, required the use of the sign (-) or the words 'decreased by' before the actual figure for the difference. There were a few candidates who did not know how to record a measurement of 55 mm and recorded 50.5 mm, and 63 mm as 60.3 mm, incorrectly.

(ii) This question required an explanation for the changes in length measured in **(i)**. Many candidates realised that osmosis was involved and defined the process and then continued to explain the changes with a decrease for the 'chip' submerged in concentrated salt solution and an increase in length for the 'chip' submerged in distilled water. Although the direction of flow of water out of and into the 'chips' was explained, the direction of the gradient was not always clearly given. It is the cell membrane that is the partially permeable structure that allows the passage of water by osmosis.

Common errors for less able candidates included description of the changes recorded in **(i)** and not an explanation. Muddled ideas of salt movement and active transport were seen.

(b) This part of the question focused on the results for an investigation involving changes in mass which were provided in a table.

(i) The percentage change in mass of the 'chip' in the most concentrated sucrose solution needed to be calculated. Most candidates showed good mathematical skills to complete this calculation and many showed the working in the space provided. Those that were unable to calculate this percentage often then did not continue to plot the graph in **(iii)**.

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(ii) The table recorded the mass of the 'chip' at the start in grams and these values differed with the different chips. The only way to compare the changes at the end was to calculate the percentage change. Only some of the able candidates realised this point by looking back to the data, but many candidates missed this point giving general answers that referred to reliability or accuracy but not explaining why this was so.

(iii) A line graph should be used to plot the two continuous sets of data, the percentage change in mass against the concentration of the sucrose solution. Most candidates did use a line graph to present this data, only a few bar charts were noted. The axes orientation was given but the scaling of both of these axes gave problems to candidates. The *y*-axis needed to be scaled to show the increase in mass above the *x*-axis and the decrease in mass below this horizontal with a negative sign to distinguish the two types of change. The concentration of sucrose solution in g dm^3 needed to range from 0 to 350 g dm^3 with the intermediate values spaced evenly across the whole range and not the five values given in the table spaced at equal intervals. Plotting the points was carried out accurately. The last point to be plotted for the 345 g dm^3 was often the one that was incorrectly set at 325 instead of 345 g dm^3. Most plotted points were neatly shown though there is a tendency to make 'dots' or 'crosses' too large. The points were generally shown by means of ruled lines that needed to pass through each of the plotted points and to be constructed with thin lines (not thick lines that obscure the plotted points). The line should finish at the last plotted point and not be extrapolated beyond this.

Weaker candidates, especially those who did not calculate the percentage change in mass for **(b)(i)**, seldom attempted to plot the graph.

(c)

(i) Recording the concentration of sucrose solution in which the mass of the 'chip' would stay the same, required reading the value from the graph where the line crossed the *x*-axis. The candidates that plotted the graph were able to read off this value correctly. It was unfortunate that some of these candidates recorded values beyond this value at a far higher sucrose concentration.

(ii) The explanation required candidates to compare the water moving into the 'chip' with that leaving the 'chip' so there was a balance, resulting in 'no net movement of water'. Osmosis will not stop as the cell membranes are partially permeable. Able candidates used this terminology or an alternative to express the idea of equality in many different ways. Weaker candidates repeated the wording of the question and did not explain the reason.

Question 3

This question was based on insects and the classification of arthropods.

(a)

(i) The three drawings of insects involved **A**, a fly, **B**, a dragonfly, and **C** a worker ant. Some candidates identified three insect features common to all of these images correctly but many other candidates only referred to features such as legs or antennae without recording the number of these structures. This is important as the number of legs distinguishes the insects from the arachnids. Insects have many segments; it is the number of body parts; head, thorax and abdomen that again is important to distinguish these arthropods from the arachnids.

(ii) Visible differences between these three insects other than size directed many candidates to correctly record the number of wings between **A** and **B** and between **A** and **C.** Weaker candidates misidentified the antennae of **C** and recorded the number of legs as four pairs.

(iii) Most candidates recorded the three arthropods as belonging to the Insect group.

(b) The arthropods are a complex and ancient group of animals and in the syllabus three groups other than insects are named; the crustaceans, arachnids, and myriapods. It was surprising to note the range of incorrect groups that candidates thought to be classified as arthropods.

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The common group to be correctly given was the arachnids; the two features being described were such as number of legs and parts of the body – cephalothorax and abdomen. A few candidates recorded these two parts incorrectly indicating that the head was separate to the cephalothorax.

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Paper 0610/63
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Key Messages

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Candidates are advised to use an HB pencil for drawings and to erase all incorrect lines thoroughly with a good rubber.

General Comments

On the whole most candidates performed very well on this paper. The great majority attempted all questions and appeared to have had sufficient time in which to complete the paper. The standard of English was good and work was usually well presented and legible. In general, candidates could improve their performance by reading questions carefully and giving precise and relevant answers. There were some areas where specific improvements could be made and these will be clarified below.

Comments on Specific Questions

Question 1

This question was based on an investigation on reaction times that were estimated by how quickly a subject could catch a ruler that was dropped vertically.

(a)

(i) Candidates were asked to read a measurement from a diagram showing a ruler that had just been caught. Nearly all candidates gained credit here. There was a wide range of answers accepted as correct as the measurement could be taken from the top or bottom of the thumb, and could extend to the 0 cm mark or to the bottom of the ruler.

(ii) Having inserted the reading from **(i)** into a table of results, candidates were then asked to calculate the average. Slightly more candidates gained credit here than in **(i)** as a correctly calculated average gained credit even though the answer to **(i)** may have been incorrect.

(b)

(i) Here the candidates were asked to state the purpose of the investigation that had previously been described. Many candidates did not appreciate the purpose of testing both hands and confined their responses to speed of reaction in general. This was the case for candidates of all abilities, although the trend was more marked in those candidates who were less able. The latter tended to answer by quoting portions of the text. It would be helpful for candidates to realise that all the information they are given is of relevance and needs to be considered. Those candidates who attempted an explanation of the nervous pathway involved (and the speed of the impulse along it) usually needed to provide more detail than was given.

(ii) The requirement here was to state three variables that had to be kept constant throughout the investigation. The average candidate gained partial credit, usually for noting the necessity of keeping both the ruler and the candidates involved the same. Few candidates gained full credit. A common misconception was that dropping the ruler from different heights would affect the results. A number of candidates repeated different aspects of the same marking point i.e. the ruler having the same length, same weight and the same

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thickness. Few candidates considered the time of day, environmental conditions, the alertness of the candidate, or the method in which the ruler was dropped. Candidates need to be made aware that precision is required in stating their answers and that the Examiner cannot carry out an interpretation of a vague response.

(c)

(i) Candidates were given a table for converting the ruler distances into reaction times. This had to be used to estimate the reaction times from their results. There were generally good judgements made from the table of reaction times, with the majority of candidates gaining full credit. Slightly more candidates calculated the correct answer for the left hand than for the right. A few candidates misplaced the decimal point and others estimated between the wrong set of numbers.

(ii) Candidates were asked to draw conclusions from their results. An improved exam technique would help candidates in questions such as this: i.e. where a question carries two marks, then two distinct statements need to be made in the answer. Many candidates stated marking point two (the right hand had a shorter reaction time than the left) but did not attribute this to right-handedness. Few candidates appreciated that the reaction times decreased as the trials progressed.

(d) The final requirement was for candidates to state how the original investigation could be adapted to test for the effect that stimulants had on reaction times. Weak answers just described the theoretical nature of depressants and stimulants in general. Of those who described an experiment, almost all used the given example. The most frequently awarded marking points were for using the same candidate (with and without a stimulant) carrying out repeat investigations and for comparison of the results in order to reach a conclusion. The other marking points (of which there were a further eight) were rarely mentioned and it was invariably the more able candidates who did offer other points such as the use of more subjects, use of standardised subjects, use of identical doses, allowing time for the drug to become effective and ensuring that the drug was safe to use. Candidates need to be aware that using a control in an experiment needs to be explained (and that the phrase "use a control" will not normally gain credit unless precise detail is given). Sometimes it was not clear when a candidate mentioned repeats, whether the whole investigation was referred to, or the three trials within the experiment as described. It is evident that candidates, of all abilities, require further guidance and practice in planning investigations.

Question 2

(a) Candidates were asked to make a large labelled drawing from a photograph of a raspberry fruit. There were many excellent drawings produced, with candidates across the ability range gaining full credit by producing diagrams that were drawn in pencil, were larger than the photograph, had no artistic shading, and were accurate in terms of shape, size and number of component parts. The marking point most frequently not awarded credit was the one for the drawing the arrangement of the fruitlets, where often these were represented as overlapping ovals or with spaces in between them. The remains of the stigma / style were frequently drawn too large and wide (or omitted altogether) and labelled as hairs or hooks. Most drawings were labelled, some in great detail, but many candidates labelled sepals as leaves.

(b)

(i) Candidates were given a chart of the number of fruitlets found in a selection of raspberry fruits. These numbers had to be used to complete a tally chart placing the raspberries into classes according to the number of fruitlets present. Nearly every candidate achieved full credit here. A few candidates had clearly counted and completed the totals and subsequently filled in the tally which sometimes led to errors.

(ii) Using the tally chart, candidates were asked to construct a histogram. Some excellent histograms were produced with many candidates gaining full credit for the histogram axes being correctly orientated and clearly labelled, the histogram filling more than half the printed grid paper, bars placed accurately and drawn neatly touching each other. A common point of difficulty was the labelling of the axes and in positioning the class size centrally under each column. Some candidates did not extend the lines of the histogram bars down to the *x*-axis. Very few candidates drew line graphs, but more produced bar charts (with gaps between the bars) rather than a histogram.

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(c) This question presented candidates with more of a challenge. Some referred to dispersal of the seeds rather than the type of distribution shown by the graph. Other candidates wrote about continuous and discontinuous variation. As with **Question 1(c)(ii)**, candidates should be aware that two points had to be made to gain full credit. Some candidates recognised the normal / unimodal distribution and others that the 70 – 79 class was the most common, but few stated both.

(c) Many candidates gave clear, full and detailed explanations of how the animal dispersal functioned, knowing that the fruits would be eaten, pass unharmed through the digestive system of the animal and be deposited away from the parent plant when the animal defecated. A few mistakenly thought that the "hairs" on the fruitlets attached to the fur of the animal. Less able candidates confused dispersal with pollination.

Question 3

(a)

(i)(ii) There were some excellent diagrams showing the positions of the vascular tissue in cross sections of stem and root. On the whole, candidates were more familiar with the stem structure than with that of the root. On the other hand, many candidates drew isolated xylem and phloem cells, longitudinal sections (which did not show the required distribution of xylem and phloem) complete root systems or unrecognisable diagrams with labels of xylem and phloem attached. This question discriminated well between able and less able candidates.

(b)

(i) Less able candidates gave the answer as glucose or fructose. The correct answer of sucrose was not well known even by the more capable candidates.

(ii) Starch was known by significantly more candidates than those who gained credit in **(i)**.

(c) Candidates tended to make errors here by firstly referring to iodine and not iodine solution (or drops) and secondly by stating the final colour for a positive result and not giving the colour <u>change</u>. Many candidates also included the details for testing a green leaf for the presence of starch and relatively few gave details on finding out <u>where</u> in the root the starch might be located.

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