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BIOLOGY

Paper 0610/11
Multiple Choice

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

General comments

The paper proved to be well within the capabilities of the candidates who took it, and there were some very impressive performances. A very small minority of candidates scored full credit.

Comments on Specific Questions

Question 7

The presence or absence of a cell wall and its position in a cell is a topic with which candidates often struggle. However, many candidates identified the correct answer.

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Question 20

Only living things can photosynthesise, and thus they must release energy from respiration to remain alive. However, this is an unlikely explanation as to why a significant number of candidates chose option **D**, suggesting that respiration relies on the Sun's energy. It is more likely that they did not link peristalsis with a muscular action that requires energy. A high proportion of those opting for the correct answer did well on the test as a whole.

Question 23

Traditionally, the way in which ciliary muscles operate to alter the focal length of the lens is a difficult topic. It was, however, rather disappointing to note that there were more candidates opting for the exact opposite of what happens than opted for the correct answer, although, again, this was not true of the more able candidates.

Question 28

Many candidates appear to be confused by the distinction between the processes of growth and development. This was illustrated by this question with a significant number of candidates opting for mitosis, a growth process, rather than a cell becoming specialised to form phloem.

Question 30

Many candidates have difficulty with the terms meiosis and mitosis, and a significant minority suggested that meiosis leads to genetically identical gametes. This is an area where more careful learning could be applied.

Question 31

There appeared to have been some guesswork here from those who became confused while working out the likely ratio from crossing a heterozygous individual with a homozygous recessive one. A considerable number of candidates incorrectly chose option **C**.

Question 32

This required a piece of simple knowledge, and the majority of candidates were able to answer correctly.

Question 35

A significant minority of candidates thought that the breakdown of glucose was involved in the recycling of energy. This suggests that either they did not consider the more plausible possibilities of water and/or carbon dioxide, or they erroneously believed that energy is recycled. However, this misunderstanding appeared to be limited to those who did not perform well on the test as a whole.

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BIOLOGY

Paper 0610/12
Multiple Choice

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

General comments

The performance of candidates on this paper was generally most encouraging with even the most difficult questions discriminating between candidates of differing ability.

Comments on Specific Questions

Question 4

The presence or absence of a cell wall and its position in a cell is a topic with which candidates often struggle. However, many candidates identified the correct answer.

Question 7

Some of the more able candidates struggled with the level of organisation shown by elements in the xylem. A large minority thought that a group of xylem vessels would form an organ rather than a tissue.

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Question 8

A significant number of candidates believed that a contracting muscle uses the same amount of oxygen as a relaxed one. This appears to indicate that they failed to appreciate that the energy required for contraction comes from a process that requires the provision of oxygen.

Question 16

This question proved difficult, even for the more able candidates. It was hoped that they would recognise that the walls of the left ventricle are thicker/more muscular than those of the right ventricle, but the question also required them to realise that the section was taken through the ventricles rather than through the atria. This proved too demanding for the majority. It is most probable that, if asked to describe the structure of heart ventricles, many would make an accurate comparison of wall thickness.

Question 24

It would appear that candidates are not entirely comfortable with the function of the choroid coat in the eye, as there was evidence of guesswork, even though the lens and the fovea would not be expected to be likely contenders for the particular role of preventing internal light reflection.

Question 28

Some candidates appear to be confused between growth and development. All the incorrect options referred to growth, while only the correct answer described development. This point was recognised by the more able candidates.

Question 34

Fossil fuels seem often to be a less familiar part of the carbon cycle. This was illustrated here by a considerable number of candidates believing that the Sun's energy is used for water absorption, even though many of the same candidates would most probably state that the uptake of water by osmosis is a case of (passive) diffusion. This indicates not only the lack of a sound grasp of the part played by fossil fuels, but also a misunderstanding of the process of water absorption by plants.

Question 35

This question showed that many candidates are confused over whether energy is absorbed or released by photosynthesis and respiration. In this instance, a significant minority of the candidates incorrectly chose option **D**.

Question 39

A large number of candidates incorrectly chose option **B**, believing that cutting down trees leads to high levels of pollution. It may be that there is confusion between the terms pollution and conservation, or the lack of it.

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BIOLOGY

Paper 0610/13
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3	**C**	23	**B**
4	**C**	24	**A**
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7	**B**	27	**A**
8	**B**	28	**D**
9	**A**	29	**D**
10	**C**	30	**A**
11	**D**	31	**B**
12	**A**	32	**A**
13	**C**	33	**C**
14	**C**	34	**B**
15	**D**	35	**A**
16	**A**	36	**B**
17	**B**	37	**D**
18	**C**	38	**A**
19	**C**	39	**B**
20	**A**	40	**D**

General comments

This paper fell well within the capabilities of most candidates, with a full range of marks scored.

Comments on Specific Questions

Question 6

The presence or absence of a cell wall and its position in a cell is a topic with which candidates often struggle. However, many candidates identified the correct answer.

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Question 19

Only living things can photosynthesise, and thus they must release energy from respiration to remain alive. However, this is an unlikely explanation as to why a significant number of candidates chose option **D**, suggesting that respiration relies on the Sun's energy. It is more likely that they did not link peristalsis with a muscular action that requires energy. A high proportion of those opting for the correct answer did well on the test as a whole.

Question 21

Traditionally, the way in which ciliary muscles operate to alter the focal length of the lens is a difficult topic. It was, however, rather disappointing to note that there were more candidates opting for the exact opposite of what happens than opted for the correct answer, although, again, this was not true of the more able candidates.

Question 27

This required a piece of simple knowledge, and the majority of candidates were able to answer correctly.

Question 32

A significant minority of candidates did not understand the uni-directional flow of energy. However, only a very small minority believed that energy flows in cyclic fashion.

Question 33

Many candidates appear to be confused by the distinction between the processes of growth and development. This was illustrated by this question with many candidates opting either for mitosis, a growth process, or fertilisation.

Question 36

A significant minority of candidates thought that the breakdown of glucose was involved in the recycling of energy. This suggests that either they did not consider the more plausible possibilities of water and/or carbon dioxide, or they erroneously believed that energy is recycled. However, this misunderstanding appeared to be limited to those who did not perform well on the test as a whole.

Question 39

This question was competently answered by the vast majority of candidates. No candidates chose the incorrect option **A**, a food web pyramid .

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BIOLOGY

Paper 0610/21
Core Theory

Key Messages

Candidates should be reminded of the need to read the questions thoroughly and to take note of each question's demands.

Candidates should be careful not to use terms they are trying to define as part of the definition as so often the response proves to be inadequate for credit. An example could be "diffusion is when particles diffuse" or "fertilisation is when a sperm fertilises an egg cell".

General comments

A significant number of candidates did not attempt all parts of all questions. This did not appear to be linked to a lack time to complete the paper, but rather to inadequate preparation or knowledge of the subject matter. Areas of the syllabus that were found to be the most challenging included the female reproductive system, sweating and vasodilation and asexual reproduction.

Comments on specific questions

Question 1

A significant proportion of the candidates wrote the mnemonic "MRS GREN" in a blank area of the page. These candidates regularly gained full credit in both **(a)** and **(b)**. Many other candidates tried to describe what was happening, e.g. having food, knowing what is happening around them. When the question requested characteristics of living organisms, many answers were only related to animals, and omitted plants. In **(a)(i)** and **(a)(iv)**, many candidates referred to breathing, while a number linked **(a)(ii)** to movement. Even the candidates who were unable to gain much credit in **(a)** were generally able to answer **(b)** correctly.

Question 2

A number of candidates ignored the instruction in **(a)** to draw one line from each pollutant; some left pollutants unconnected to any of the effects and therefore could not be awarded credit. Common errors showed carbon monoxide connected to the rise of global temperature, and insecticides connected to the spread of diseases such as cholera. In **(b)** many candidates overlooked the request for a source of each of the pollutants and instead described its effect, e.g. **(i)** reducing the carriage of oxygen in the blood. Others named such a pollutant, e.g. **(iii)** alpha or gamma rays. Candidates should be aware that carbon monoxide is produced by combustion when there is a limited supply of oxygen. The source of carbon dioxide is from respiration, combustion or decomposition rather than from the lungs or breathing out.

Question 3

The definitions of diffusion where regularly confused with statements about osmosis. Candidates should be aware that diffusion is simply the random movement of molecules or ions from a high concentration to a low concentration. The plotting of the data in table 3.1 was normally very precise, but although most drew a line of best fit, a number omitted to label this line. Most responses to **(b)(ii)** correctly identified sample **C** as the sample that took the longest time to travel along the tube, but then a significant number of these candidates also gave sample **C** as their response to **(b)(iii)**, stating that it was the most concentrated sample, and explaining that it was the one that took the shortest time, thus contradicting their answers in **(b)(ii)**. Responses for **(b)(iii)** should have identified sample **B** and linked this to the fastest rate of movement along the tube. In **(c)** again there was confusion between osmosis and diffusion. Candidates should be aware that osmosis applies only to the movement of water molecules and that it only occurs in the presence of a

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partially permeable membrane. Responses that did not point out differences but only repeated correct statements about diffusion did not gain any credit in this section.

Question 4

There was a lack of both knowledge and understanding in general about the female reproductive system. Throughout responses to parts **(a)**, **(b)** and **(c)** of this question there was considerable confusion over the terms ovum, ovule and ovary. Candidates should use the term ovum, or egg cell, to describe the female gamete, and the term ovary to describe the structure that produces these gametes. They should also be aware that the term ovule is not used to describe animal female gametes, but is restricted to a structure, found in the ovary of flowering plants, that contains the female gamete. Very few candidates were able to identify a function of each of the labelled structures, **M** and **N**. Many simply attempted to name or describe each of the structures and these responses were not always correct. Few appreciated that **O**, the ovary, produces both ova and also female reproductive hormones such as oestrogen and progesterone. It is not however the site of fertilisation which normally occurs within the oviduct, **N**. Responses to part **(b)** were very muddled and frequently incorrect. Many candidates described the shedding during menstruation of the whole uterus, or vagina, or even the ovaries. They should be aware that it is only the lining of the uterus that develops and is later broken down and shed rather than its muscular walls. The ovaries were quite frequently described as releasing egg cells, but many candidates also described them as travelling along the oviducts to be implanted in the uterus or if unfertilised then broken down and shed.

Fertilisation was often described as sperm meeting an ovum but with no reference to them joining or fusing. Responses that described fertilisation by simply stating “the two gametes fertilise one another” was not considered adequate for credit. Few candidates linked oestrogen to the control of the development of secondary sexual characteristics at puberty, but most could identify at least one such characteristic.

Question 5

A significant number of candidates were unable to label the diagram of the skin correctly, and some did not attempt to add labels at all. Some labels were for structures that do not occur in the skin, or even do not occur in animals, which suggested that many candidates were unfamiliar with the structure of the skin. Erroneous labels included stomata, xylem, villi and alveoli. It was expected that candidates would identify and label structures such as capillaries, sweat glands, hairs and temperature receptors. In part **(b)** there was little knowledge or understanding shown in the responses describing how sweating and vasodilation helped to lower body temperature. Many candidates did not attempt to explain the purpose of vasodialtion. Both processes were frequently linked to the hairs on the skin. Candidates should be aware that it is only the water in sweat that evaporates and not the salts and other substances dissolved in the liquid sweat. A number of candidates thought that the capillaries, and other blood vessels, move up and down in the skin to allow them to be nearer or further away from the skin’s surface. The blood vessels do not move within the skin. Many candidates gave rather vague responses to part **(c)** and did not seem to recognise that the skin is a sensory organ with a surface layer that is waterproof and normally prevents the entry of pathogens and harmful chemicals.

Question 6

Few candidates were able to state at least one of the main features of asexual reproduction in part **(a)** and even fewer could describe the process of asexual reproduction by potato plants. In both parts **(a)** and **(b)** there were very many references to gametes, fertilisation, pollen and pollination. Asexual reproduction seemed to be confused with self-pollination in a number of responses. There was little understanding that the offspring of asexual reproduction were genetically identical to each other and to the parent and that they were derived from a single parent, the sex of which was irrelevant. Some candidates clearly thought that this single parent was an hermaphrodite as they referred to it producing both female and male gametes. Also few understood the processes that resulted in a single potato plant, grown from a tuber, giving rise to many new tubers each of which could be grown into new potato plants. In **(c)**, a significant number of candidates understood that both bacteria and fungi commonly reproduce asexually.

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Question 7

Many candidates gained full credit for labelling the phases on the population curve, and when errors did occur it was mostly the placement of the letters **E** and **L** which were often reversed. The major factors that could affect the rate of growth of this population were regularly listed as the availability of food, the occurrence of diseases and the presence of predators.

Question 8

Most candidates were familiar with some of the features of enzymes and their function within the body, although some did not appreciate that enzymes are involved in virtually all chemical reactions within the body and not just in digestion. In **(b)** there were many candidates who tried to emulate the form of the graph curves in Fig. 3.2 and drew a single straight ascending line ignoring the plotted values at 65 °C and 75 °C. Their attempted lines of best fit were regularly extrapolated well beyond the highest plotted value at 55 °C. The optimum temperature in virtually all cases was taken to be 55 °C, while credit was given for the rate of starch digestion wherever the graph curve crossed 37 °C. In **(b)(iv)** many candidates did not restrict themselves to a description but tried to include an explanation as well which often meant that the description of the effect of temperature on starch digestion was only half completed. In **(v)** it was expected that candidates would appreciate that the sample originally incubated at 75 °C would not bring about digestion at the optimum temperature, as the enzyme had already been denatured, but that the sample originally incubated at 15 °C would, at the optimum temperature, bring about rapid digestion of the starch as it had been too cool to digest starch earlier but had not been denatured.

Question 9

In both diagrams the label for xylem, **X**, should have been the upper of the two labels, while that of phloem, **P**, would occupy the lower label space. However, some candidates were uncertain which tissue was which and they regularly reversed whatever labels they had used in diagram **A** when labelling diagram **B**. Although many understood that the xylem transports water and mineral salts, far fewer realised that it had a supporting function in roots, stems and leaves. In **(b)(i)** some did not understand the translocation of the materials in the phloem, amino acids and sucrose. In **(b)(ii)** it seemed that candidates confused translocation with transpiration.

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BIOLOGY

Paper 0610/22
Core Theory

Key Messages

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. This might avoid responses being duplicated, which rarely gain credit.

The amount of credit available for each question part should be noted as this is an indication of how much information is expected in a response.

General comments

Most candidates appeared to have sufficient time to complete the paper and virtually no whole questions were left totally blank. Some candidates showed very limited knowledge and understanding of some topics from the syllabus, especially genetics and deforestation, and many could not apply basic principles in unfamiliar situations, such as in **Question 4**. Almost all candidates found at least some aspects of this paper demanding. Some candidates appeared to have considerable difficulty in expressing themselves clearly where explanations were required.

Comments on specific questions

Question 1

This question presented few problems to most candidates, with the majority gaining full credit. The commonest error was to misidentify **A**. A few individuals tried to give the common names of the species or put several letters in each box.

Question 2

Many of the candidates found this question challenging. In many cases the functions of the various chambers of the heart and their associated blood vessels were not known. The thickness of the ventricle walls should have guided candidates to selecting the right and left sides of the heart and enabled them to identify structures passing deoxygenated blood to the lungs in **(a)(i)**. Valve **V** is clearly between a ventricle, **H**, and a blood vessel, **E**, but a significant number of candidates suggested that it prevented backflow from the ventricle to the atrium. Others believed that valves push the blood on its way around the body. In **(b)(i)** many wrote about breathing rate although the question was about pulse rate. The need for extra energy during exercise was known, but this was not always related to muscle action or to the need to supply the muscles with more oxygen and glucose to supply this energy. In **(b)(ii)** most candidates knew that pulse rate is normally timed over one minute but a suitable site at which to make the measurement was not always identified. A significant minority thought it could be measured on a vein.

Question 3

In **(a)(i)** many candidates did not appear to appreciate that starch formation would only occur in area **L**. In **(ii)** they were unable to explain that both chlorophyll and light must be present for photosynthesis and starch formation to take place and that this only occurred in area **L**. Most recognised the process as photosynthesis, but a number thought that carbon dioxide was released in this process. Most candidates struggled in part **(b)** with many not knowing where or how mineral ions such as magnesium enter a plant. Many suggested that they entered through the stomata.

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Question 4

Many candidates were unable to name the structures on the diagram. The urethra, **B**, was correctly identified more often than the prostate gland. The site of testosterone production was clearly and correctly indicated in only a minority of cases. Some candidates placed the point of their arrow on the boundary between the testis and the epididymis, possibly hoping that the Examiner would choose the correct response, while others placed this in the bladder or the prostate gland. None of these attempts gained credit. Many were able to name the stage in development in **(a)(iii)** as puberty. In **(b)** many candidates were unable to select from their knowledge of the effects of testosterone, (secondary sexual features of males), two features which might enhance athletic performance. Candidates are expected to know that radiation is a possible cause of mutations and apply this knowledge to explain why the testes should be protected from such effects, but many simply stated that sperm might be destroyed or damaged.

Question 5

Most candidates correctly selected Brazil as the country with the largest area of rainforest and were able to calculate the area of rainforest lost in the Philippines over the 15 year period, but the percentage calculation in **(a)(iii)** proved more difficult. Many candidates confused the harmful effects of deforestation with the effects of global warming. Some mentioned loss of habitats for wildlife but few mentioned the disruption to food chains or the possible extinction of whole species from this ecosystem. Physical effects such as increased soil erosion or changes in drainage were rarely mentioned. Some candidates realised that burning the remaining vegetation would increase the carbon dioxide content of the air, but few also commented on the loss of photosynthetic material and how this might alter the composition of the air. A number speculated that the air might run out of oxygen.

Question 6

In **(a)** many candidates were unfamiliar with the term homeostasis, and a surprising number suggested that feeding or digestion would remove glucose from the blood. Most candidates were able to extract the correct data from the graph in **(b)**, but few were able to identify the point at which the pancreas started to increase production of insulin. Few realised that this must be before the concentration of glucose in the blood began to fall, not after this point. The effect of the fight on the blood glucose level was well known, but a surprising number thought, erroneously, that the hormone produced was testosterone rather than adrenaline. Effects of adrenaline on the body were not well known, with many just suggesting that it would make him stronger, which was too vague to be awarded credit.

Question 7

Part **(a)** about insect pollination was well answered, although unqualified responses such as colour and petals were considered too vague to gain credit. Knowledge of the events leading to fertilisation was very poor. The development of a pollen tube was rarely described and many suggested that the whole pollen grain rather than the male gamete fused with the female gamete. Some candidates failed to mention fusion of gametes at all. A few candidates wrote here about germination.

In **(c)** only a minority of candidates showed a clear understanding about the likely genetic make up of the seed or why its genotype was likely to be different from that of the parent plant. Very few suggested that environmental conditions were likely to affect the growth of the seedling after germination.

Question 8

Most candidates completed the pyramid of numbers correctly, but a significant minority did not realise that leaves are not organisms and that they should have put the tree at the base of the pyramid. Most also realised that the pyramid of biomass would be widest at its base and were able to label this correctly, but the reason for the difference in shape of the two pyramids was not understood. In **(b)** most candidates correctly named a herbivore and a carnivore but were unable to name a suitable group of organisms in **(iii)**.

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Question 9

There was evidence that candidates did not read this question carefully enough. In **(a)** candidates were asked how light intensity changed, but a significant number of responses were about the changes in the pupil brought about by the change in light intensity. In **(a)(ii)**, some candidates used the terms iris, pupil and even eye as if they were synonymous, which lead to considerable confusion.

Part **(b)** was about the pupil reflex, but many simply repeated information from **(a)(ii)** here, without stating that reflex actions were very fast and automatic. Many did not seem to realise that the pupil reflex protects the cells of the retina from excessive light which would damage them. Very few candidates mentioned the retina at all.

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BIOLOGY

Paper 0610/23
Core Theory

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BIOLOGY

Paper 0610/31
Extended Theory

Key Messages

1. Before starting to answer a question candidates should read through the whole of the question in order to decide what is required in each part. Candidates who fail to do this often repeat the same ideas in several parts of the question.

2. Candidates should be advised not to rewrite the question before starting their answer. Candidates who do this often run out of space and do not give the required number of points in their answer.

3. If it is necessary to continue an answer on a blank page or on a supplementary sheet, candidates should indicate that there is a continuation and its location.

4. Candidates should take great care over the spelling of terms or 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.

5. Where a candidate wishes to change an answer they should be advised to cross out the original answer clearly and write the new answer above, below or at the side of the original answer. This is especially important where letters or data values are required in an answer.

6. Care should be taken with teaching detailed information that goes beyond the requirements of the syllabus. Some answers to **Question 4(a)** revealed some confusion between *antibodies* and *antibiotics* possibly because candidates seemed to have been given a lot of detailed information.

General comments

The Examiners marked a number of excellent scripts which displayed a thorough understanding of all the topics on the paper. There was little evidence that candidates had insufficient time to complete the paper. Most candidates attempted all questions and there were few blank responses. **Questions 1(b)(ii)**, **2(a)** and **5(a)(ii)** proved to be high scoring questions for many candidates.

Questions 2(d), **3(e)**, **4(a)**, **6(b)** and **6(d)** all proved challenging for many candidates. In **Question 2(d)**, candidates tended not to focus on the similarities in DNA within a species or differences between species. In **Question 3(e)** many candidates misread the graph and assumed the lines represented changes to the pH of the solutions rather than changes in the activity of the enzyme. In **Question 4(a)** many candidates were unable to give a clear explanation of the roles of antibodies in the protection from disease. This did not appear to be clearly understood. In **Question 6** many candidates were unable to differentiate between the responses required in each section of the question.

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Comments on specific questions

Question 1

This question proved to be a good introduction to the paper for most candidates. Part **(a)** involved matching functions to parts of the digestive system and part **(c)** required candidates to use information from different parts of the syllabus (***Sections II*** and ***III***) to describe the sequence of diagrams showing the events that follow a cut to the skin.

(a) Most candidates were able to identify the organs that perform protein digestion, many were able to identify the organs responsible for insulin production, deamination and mixing partially digested food with bile. Fewer candidates were able to identify the organ where most water is absorbed; the Examiners expected candidates to know that this was the small intestine (label **E**), but many candidates incorrectly stated that it was the large intestine (label **G**).

(b) (i) This was generally a well answered question with many scoring full credit. Most candidates were able to identify that proteins were synthesised from amino acids although a few suggested peptides or polypeptides, which are unlikely to be absorbed. Many candidates also identified glucose as being the nutrient absorbed to synthesise glycogen but those who used the term 'sugar' or 'simple sugar' failed to gain credit. Fewer candidates stated that both fatty acids and glycerol are needed to synthesise fat, with many giving instead lipids, or fatty acids or glycerol alone.

(ii) Most candidates were able to identify that calcium was the mineral needed to make bone. The Examiners accepted phosphate and magnesium, although these were rarely suggested. Most candidates were similarly aware that iron is needed for the manufacture of haemoglobin; care needed to be taken with the spelling here as 'ion' or 'ions' were not accepted since they may refer to many other chemicals.

(iii) Proteins, carbohydrates, fats and minerals had been mentioned in the two previous sections. This part was less well answered. Many candidates suggested other minerals, water or fibre. The Examiners credited vitamins or any named vitamin.

(c) Many candidates successfully used information from the diagrams and gained some credit. To gain full credit it was necessary to give a logical sequence to the events which cause clotting of blood and the healing of wounds. Many were able to state that platelets are involved in the process, although fewer were able to suggest that these were important in the promotion of clotting; the more common misconception was that platelets engulf bacteria or heal the skin or capillaries. Several candidates were able to explain the role of thrombokinase, prothrombin and thrombin in the conversion of fibrinogen to fibrin, and most explained that the insoluble fibrin was responsible for forming a mesh that trapped blood cells and/or prevented blood loss. Most candidates stated that a scab formed, although fewer associated this with the clotting process. It was common for candidates to focus on the role of the phagocytes shown in the diagram, with many recognising that they engulf bacteria or pathogens. Candidates should avoid using the word 'germs' for bacteria. Candidates should not refer to phagocytes *fighting* bacteria or engulfing foreign *objects*. A significant number believed that the phagocytes make new skin cells or capillary tissue. Most candidates referred to the formation of new skin or capillary tissue, but very few were able to state that this was the result of mitotic division of cells. Candidates who stated that capillaries or skin are repaired needed to explain the processes by which the repair is achieved.

Question 2

(a) Most candidates scored well on this question showing good knowledge of mammalian features. Common incorrect features stated included: soft skin, internal fertilisation, not laying eggs, a visible ear and the presence of four limbs. A number of candidates defined mammals as having feathers or wings.

(b) Answers to this question varied widely. A significant number of candidates focused solely on the idea of mammals being warm-blooded, although some misunderstood the term, clearly believing that this means that the animal has hot blood which keeps them warm. Several candidates referred to vasoconstriction. In such cases it is important to ensure that the location of this process is clear and the consequence in terms of altered blood flow is correct. Some candidates wrote about blood vessels 'moving away from the skin surface'. It was common for candidates to refer to fat or blubber in mammals although many failed to locate it in or under the skin, giving the

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impression that the body was enclosed in fat. Most candidates referred to the hair or fur that covered the mammal and were credited for this. The sea otter referred to in the question has thick fur. Some candidates were able to explain the heat retention achieved by the erection of hair and the trapping of air between the hairs. Candidates should realise that the hair itself does not insulate the animal. A common misconception appears to be that hair lying flat traps air/heat and erect hair loses air/heat. Several candidates explained that mammals are able to generate heat by muscle contraction, metabolism or respiration. Candidates should avoid ideas such as fat or glucose being burnt to generate heat, which occurred in a few scripts. Although the question referred to mammals and reptiles of similar size, credit was given to the few candidates who referred to the heat retention of animals with small surface area to volume ratios.

Some candidates focused on respiratory differences between mammals and reptiles which enable them to remain under water; this was not the focus of the question. It was surprising to see some candidates referring to mammals with gills.

Many candidates were too emphatic about heat loss being prevented altogether rather than being reduced. The same problem occurs when candidates answer questions on transpiration; some xeromorphic features reduce water loss, but they do not prevent it.

(c) The syllabus defines a population as a group of organisms of one species, living in the same area at the same time. Few candidates were able to give the complete definition; common mistakes were that candidates failed to state that it referred to one species and/or failed to include *at the same time*. Candidates should be informed of the importance of language here; 'a *group of species'* would not gain credit whereas '*a group of a species'* would. A surprising number gave a good definition of a species here even though not required.

(d) There were very few acceptable answers here. Some candidates referred to DNA testing as a means of identifying an individual, but very few recognised that members of different species would have different DNA or genes. Several candidates, often those who did well on the rest of the paper, referred to different species having different numbers of chromosomes.

(e) Many candidates referred to preventing the extinction of the species. The Examiners did not accept this as that information was given in the question. Credit was not given for suggested methods of conservation. There were many good ideas presented, including the need to maintain biodiversity, prevent the loss of gene pools, prevent disruption to food webs, control the marine algae on which they feed, help promote tourism and the possibility of finding a medical application in the future.

Question 3

Candidates who remembered the structure of seeds usually gained good credit throughout this question, although they did find part **(e)** more of a challenge, often misinterpreting the maximum activity of each enzyme as its optimum pH.

(a) There were some candidates who clearly knew the structure of a seed and were able to identify **K** as the plumule, **L** as the radicle, **M** as the cotyledon and **N** as the testa. A number of candidates confused the plumule and the radicle. Testa was commonly referred to as seed coat, which was accepted, however, 'seed shell' and 'seed cover' were not. Misspelling was an issue here, as several referred to testes or testis. There were many candidates who were unable to identify these structures at all.

(b) In general, candidates stated that the threads referred to in this question were hyphae or a mycelium; the Examiners accepted phonetic spellings of these terms. A significant number of candidates gave a wide variety of other incorrect terms including spores, bacteria, proteins and chitin, DNA, RNA or chromosomes.

(c) Candidates were generally able to state that the substrate and enzyme join together with many referring to the enzyme's active site. Some candidates simply described the diagram, rather than using any of their knowledge. Few candidates were able to explain that enzymes are specific to a substrate as a result of the complementary shape of the molecules. Several candidates described the enzyme and substrate as having the same shape. Others simply mentioned 'lock and key' with no explanation. The better answers described the separation of enzyme and products leaving the enzyme to break down other substrate molecules. Candidates should be encouraged to name the

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correct product for a given reaction and to suggest that the products separate from the enzyme not the substrate.

(d) Most candidates scored well on this part of the question giving accurate descriptions from the graph. Candidates were credited for noting the differences in the activity between the start and day 5, the change in activity between day 5 and day 11, and then the change again from day 11 to day 15. Credit was also available for accurately quoting the enzyme activity in arbitrary units on a day of their choice. Candidates should be advised to check carefully the day being quoted from the graph as several candidates made errors in this. Many candidates suggested incorrectly that the enzyme was denatured on day 11. Some candidates ignored the request to describe the activity of the enzymes in the extract at pH 5 and also included a description of the activity at pH 8 for which no credit was available.

(e) Most candidates attempted this, although they found it very difficult, failing to understand the nature of the experiment. Some were able to gain credit by referring to, or describing, the different shapes of the lines for pH 5 and pH 8, but very few recognised that the activity at both pH values was significant, or mentioned that enzyme activity is influenced by, or specific to, a pH value. Some candidates quoted data from the graph to support their suggestions, but most failed to quote data from the same day for activity in both pH solutions. Candidates clearly expected to use their knowledge of temperature change on enzyme activity which was irrelevant in this question. There were many erroneous references to the enzymes being denatured.

Question 4

Candidates often showed in part **(b)** that they have a good knowledge of blood transfusion, although they should have applied this knowledge to the information provided rather than assuming that the question was simply about transfusion.

(a) In this question candidates were able to gain credit for reference to antibodies coating or combining with pathogens, preventing their reproduction, movement around the body or entry into cells. They could also refer to the neutralisation of toxins or to agglutination and labelling for phagocytes to engulf the pathogen. Credit was also available for the development of long-term immunity. Most candidates were able to gain some of this credit and there were a number of very well constructed answers. Common errors included suggestions that antibodies engulfed or simply destroyed microbes and reference to pathogens as *germs* and antibodies *fighting* pathogens. In a number of cases candidates obviously mistook the antibodies for antibiotics.

(b) Most candidates were able to state that the kidney would be rejected. A smaller number of candidates were able to state that this occurred because the antibodies produced by the lymphocytes of the person with blood group O would attach themselves to the antigens on the lining of the blood vessels in the kidney. Many candidates suggested that lymphocytes or phagocytes attack the kidney; many also said that the kidney would be destroyed or killed. Some candidates were expecting to write about blood clotting as a result of two blood groups mixing and so failed to score credit here. A small number referred to blood group O as a universal recipient.

(c) Many candidates were able to say that there is no blood in the cornea. However, some candidates lost credit here by suggesting that there was no blood in the eye. Some candidates gave rather vague answers, such as the cornea 'not being near to blood' or 'not involved with blood'. Several referred to the cornea as being non-living tissue or not made of cells.

(d) This question was generally well answered with many candidates scoring well. Some candidates did not use the symbols required, using instead the letters A, B and O, but credit was given for this. One of the most common errors was to include only one allele in the genotype of each parent or to include two alleles in each gamete.

(e) Most candidates were able to complete this correctly. The most common error was to give only the letter A, B, AB, or O for the phenotype without identifying it as a blood group.

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Question 5

Carefully worded answers were required for part **(a)(iii)** in describing the exchanges that occur across the placenta. Many candidates provided these, although some did not make clear the direction of transfer between the maternal and fetal circulations.

(a) (i) Here candidates were asked to use the letters from the diagram to identify the blood vessels that carry oxygenated blood in the maternal and fetal circulatory systems. Candidates were not credited if they failed to use the appropriate letter. Many candidates were able to identify these vessels correctly, but some listed several letters in each box and failed to gain credit.

(ii) Many answers identified structure **T** as the umbilical cord; incorrect suggestions included the placenta and the afterbirth. Spelling of umbilical was very variable. Many candidates were able to state that the umbilical cord is tied or clamped and cut after the birth. The Examiners did not credit the suggestion that the umbilical cord is 'cut off'. A small number of candidates gained credit for stating that the part attached to the baby gradually dries, withers and drops off.

(iii) This elicited many very good answers, with candidates explaining that some of the substances, such as oxygen, nutrients, water, antibodies or hormones, pass from the maternal blood to the fetal blood, and that urea and carbon dioxide pass in the other direction. A considerable number of candidates were able to state that many of these substances pass by diffusion. Credit was given for gas exchange where the candidate failed to identify oxygen and carbon dioxide. Common errors included the passage of food rather than nutrients to the fetus, the exchange of blood itself and the passage of urine from the fetus. Candidates should realise that in a question such as this it is essential to include the direction of the exchange, as well as naming the substance being exchanged. It was rare to see candidates who were able to distinguish between the diffusion of glucose and the active transport of amino acids across the placenta.

(b) No credit was given for suggestions of roles prior to fertilisation or after parturition. The Examiners did not require roles to be assigned to each of the hormones, accepting suggestions for both. Many candidates recognised that they maintain the lining of the uterus although several candidates incorrectly referred to the 'wall' of the uterus. Credit was awarded for the prevention of menstruation and the prevention of ovulation, both of which were frequently given. A small number of candidates referred to the role of these hormones in inhibiting the release of FSH and/or LH. Several candidates made reference to their role in the development of the mammary glands. Reference to the role of the hormones in lactation was not accepted as this occurs after parturition.

Question 6

This question tested knowledge of different aspects of ***Section IV***. There was some confusion between the effects of different gases once released into the atmosphere. Future candidates would benefit from constructing tables to identify the effects of the different gases, such as methane and carbon dioxide, and acid rain.

(a) Many candidates did not understand the question properly and listed all the disadvantages of deforestation. Credit was given for the loss of habitats and for the subsequent threat to species leading to the possibility of extinction. It is important that candidates use the correct term for habitat and avoid using terms such as 'home' or 'shelter'. When referring to the effect on animal or plant populations candidates should make the distinction between the death of individual organisms and the loss of a species. Several candidates mentioned the disruption that this would cause to the food chains. When candidates refer to food chains being *affected* it is important that the effect is specified. Many candidates recognised that flooding, erosion and leaching of nutrients may result. Credit was also given for other suitable suggestions some of which included increased competition within or between species for food, space or mates, or the problems arising from migration of wildlife to other areas.

(b) There were some good responses here with full descriptions, stating that less energy would be lost, or that humans would have more energy available, and explaining that energy is lost between trophic levels, giving examples of how energy can be lost in animals. A small number stated that 90% of the energy in the animal feed is lost, or only 10% of this is available for humans in foods prepared from the animals. Credit was also given for economic or health benefits of soya in comparison to meat. Candidates should be encouraged to give sufficient explanation of these

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benefits. A significant minority referred to animal welfare which was not part of the question. Many candidates failed to gain credit in this question.

(c) There were some good answers that identified the release of carbon dioxide and methane from cattle, both of which are greenhouse gases and contribute to global warming. Less well argued was the reduction in photosynthesis arising from the reduced number of trees, the consequent reduction in intake of carbon dioxide and the reduction in oxygen production. Common errors here included the claim that there would be no photosynthesis when clearly there would still be a significant plant population. When referring to carbon dioxide concentration or oxygen production candidates should be advised to use comparative terms such as 'increased' or 'reduced' rather than high or low. A small number of candidates mentioned the reduction in transpiration and the reduction of water vapour in the atmosphere with a consequent reduction in rainfall. Candidates should be encouraged to read the question thoroughly to avoid the inclusion of effects that are not related to the atmosphere, such as changes in the soil. Phrases such as 'help to clean the air' are too vague to gain any credit.

(d) This question received very few good answers. Many candidates failed to support their suggestions with adequate argument. For example, several candidates referred to the possibility of erosion without then saying that this would remove topsoil or deplete the mineral content of the soil. Successful arguments were credited, as were ideas such as less recycling of organic matter from forest debris, loss of soil nutrients as a result of successive crop cultivation, reduction in rainfall and increase in plant pest populations.

(e) Many candidates suggested that the benefit of recycling paper was in the reduction of tree felling or forest clearance. It was required that candidates should see this as a reduction in felling, rather than a complete cessation, as it is likely that there would still be felling for other purposes. A small number were able to make other valid suggestions including the need for less landfill if paper is recycled, and the retention of forest habitats. Some mentioned reduction in burning of waste without referring to the effect that this has on carbon dioxide concentrations in the atmosphere, or suggested that un-named toxic gases would be given off during burning. A surprisingly large number of candidates claimed that paper is non-biodegradable.

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BIOLOGY

Paper 0610/32
Extended Theory

Key Messages

1. Before starting to answer a question candidates should read through the whole of the question in order to decide what is required in each part. Candidates who fail to do this often repeat the same ideas in several parts of the question.

2. Candidates should be advised not to rewrite part or all of the question before starting their answer. Candidates who do this often run out of space and do not give the required number of points in their answer. There was evidence of this in **Question 2** on this paper.

3. If it is necessary to continue an answer on a blank page or on a supplementary sheet, candidates should indicate that there is a continuation and its location.

4. Candidates should take great care over the spelling of terms or names of structures or functions. Examiners will always reward phonetic spellings so long as there is no confusion with another term that candidates should know from the syllabus.

5. Where a candidate wishes to change an answer they should be advised to cross out the original answer clearly and write the new answer above, below or at the side of the original answer. This is especially important where letters or data values are required in an answer.

6. Care should be taken with teaching detailed information that goes beyond the requirements of the syllabus. A few candidates gave transamination in answer to **Question 6(a)** possibly confusing it with protein synthesis.

General comments

The Examiners saw a full range of responses to all the questions on this paper. Almost all candidates attempted all of the questions on the paper and good candidates showed some excellent subject knowledge from different areas of the syllabus. No questions stood out as being inaccessible, although on several questions very few candidates scored full credit. **Question 5(c)** and **Question 6(d)** were not generally answered well; both questions required detailed knowledge of specific processes. In **Question 2**, there was some confusion as to where to write about the action of auxin. This led some candidates to waste time writing out the role of auxin more than once. **Question 4(c)** was also poorly answered. Answers to this question lacked accurate use of terminology; some candidates who understood how valves work did not gain credit as they wrote about the heart or valves contracting, rather than referring to named chambers or valves.

There was no evidence that candidates were short of time.

Comments on specific questions

Question 1

This question linked specialised cell structure and function in the alimentary canal and kidney.

(a) Less than half the candidates knew the term microvilli with most giving ‘villi’ or ‘cilia’ instead.

(b) This question was answered well by most candidates. A few candidates gave food groups, such as proteins and fats; others mentioned items such as dust and bacteria possibly because they were

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thinking of ciliated cells in the gas exchange system. Urea and carbon dioxide were also mentioned by candidates who considered only the kidney cell.

(c) The large surface area of the microvilli was known even if the name was not. Few linked this idea to diffusion or active transport, referring instead to absorption which is the term used in the question. Common mistakes were to describe features not of the cells themselves. The most common was to describe the features of a villus. 'Thin cells' or cells with 'thin walls' and/or 'thin cell membranes' were answers that were seen quite often. 'A good blood supply' was another common answer.

(d) This question was very well answered, but a significant minority named the large intestine, stomach, trachea or just intestine.

Question 2

Although many candidates were able to draw together their knowledge on phototropism with the stimulus material, other candidates did not pay close attention to the information about the use of blue light in the second experiment. Many confused this phenomenon with photosynthesis and therefore did not address the questions.

(a) Although many candidates were familiar with an exact definition, a number gave vague answers or confused growth with development. Many had obviously memorised a definition, even though they did not always reproduce it correctly. Most did not refer to dry mass, or used the term 'biomass' instead. A common response was to define growth as increase in cell size; this only gained credit if there was also a reference to cell division.

(b) This question was generally well answered, although many candidates may not have noticed the credit allocation, and hence gave only 'phototropism', rather than '*positive* phototropism'. Some candidates described the process instead, and there were references to geotropism.

(c) Many candidates described the results correctly, but few went on to draw conclusions in sufficient detail. A common misconception was confusing this response with chlorophyll and photosynthesis. Some described the conditions or noted that light was not detected, but did not describe the response. Quite a few noted that the seedlings grew in the absence of light. Candidates often stated that the stimulus was detected by the leaves rather than by the stem tip. Candidates also referred to the 'top of the plant' or the 'top of the shoot' rather than the tip of the stem. Candidates sometimes confused this question with part **(f)(i)**.

(d) The advantage of a positive phototropic response was generally well known, but only a small number of candidates gained credit for the seedling exposing a greater surface area to the light. Credit was lost for not continuing the answer to describe the result of the increased light absorption. Candidates sometimes misinterpreted the question and explained how it was advantageous to the researcher rather than to the plant.

(e) Many candidates were familiar with the role of auxin and could describe it confidently. Several described auxin as 'growing' on the shaded side, or auxin being killed in the light. Many failed to describe differential growth on one side and so missed some credit. Similarly, many did not qualify their answer with 'more' or 'less' when describing the plant bending. Very few candidates mentioned the role of auxin in cell elongation and references to the effects of turgor were seldom seen. A common misconception was that in tropic responses, auxin causes cell division as well as cell growth by extension.

(f) (i) Most candidates were able to describe some of the main features in the graph. Only the stronger candidates were able to give enough detailed points to obtain full credit. Several candidates did not note the lack of response in the first 30 minutes. This meant that they were unable to gain credit for the full description of the response shown by the control seedlings. A large number misread the values on the graph. Weaker answers tended to give two separate descriptions of the responses made by the plants without any comparisons between them.

(ii) There were a number of vague answers to this question. A considerable number of candidates called the pigment 'chlorophyll' and did not appear to have considered the information provided before the graph. Most candidates found it easier to answer this question from the point of view of the control (with pigment) rather than the group without the pigment.

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Question 3

This question linked ideas about ecology and conservation with classification, using the red slender loris as an example.

(a) Well prepared candidates gave clear, detailed answers. Many failed to consider abiotic factors or referred vaguely to habitats, and answers showed confusion between habitat, environment and ecosystem. There was also confusion between abiotic factors and dead organisms (with many referring to 'abiotic organisms').

(b) Although this question was misread by a number of candidates, most were familiar with the distinguishing features of mammals. Common mistakes included referring to 'warm-blooded', four limbs, breasts instead of mammary glands, and just 'ears'. This question was sometimes misinterpreted as asking for features of the loris rather than features of mammals.

(c) This question was generally answered well. Credit was not awarded for features which were not specific to activity at night. Common non-specific adaptations included small size, agility and speed, sharp claws and long limbs. Some candidates simply referred to hearing or smell without giving any qualification, such as saying 'better', 'sharper', 'keener' or 'greater'. Some candidates referred to 'large eyes' which is a feature ruled out by the wording of the question.

(d) Some very good answers were given, but many candidates did not give sufficient different points in order to obtain full credit. Protection of natural habitats and protection against extinction were the most frequent responses, but some excellent well thought out answers were also seen. Many answers were very vague or suggested that the loris would be fed, looked after, kept from predators and given medical treatment in the park. Many candidates discussed ideas about deforestation and global warming which were not relevant to the question.

(e) A large proportion of candidates referred to the binomial naming system quoting the examples of binomials from the question. Some described the use of physical features. Of the candidates who knew that DNA should or could be used, some did not say how this could be done. Another common error was to describe breeding individuals, but without referring to the fertility of the offspring.

Question 4

This question required sound knowledge of the structure and function of the human circulatory system. Although many candidates were able to apply their knowledge and answer the question confidently, others were not.

(a) Although most candidates knew that **J** was the aorta and **L** the vena cava, many candidates muddled the remaining blood vessels. Coronary artery, hepatic portal vein, renal arteries and renal veins were sometimes given.

(b) (i) Many candidates gained full credit here, mostly by correctly stating the destination of the blood in **J** and **M**. Fewer candidates mentioned the immediate source of the blood in the left and right ventricles. Several candidates compared the vessels as if one was an artery and the other a vein. Candidates did not gain credit if they stated that these arteries 'pump blood'.

(ii) This was generally well answered with many candidates stating that the veins bring blood back to the heart. Fewer stated where the blood was coming from and even fewer mentioned the large lumen of the veins or the fact that blood in veins has just been through capillaries. Some candidates lost credit because they explained why **J** and **M** had higher pressure. Candidates should have read the whole question first and seen that it is unlikely to gain credit for giving the same information twice.

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(c) Many candidates found this question challenging and were not able to fully explain this phenomenon, but a significant minority explained the sequence clearly and in good detail. Many candidates simply could not describe what the valves were doing, failed to understand the question or simply stated that backflow would be prevented but gave no detail. Some candidates tried to explain the process but got mixed up with chamber names or direction of flow. The Examiners often saw comments such as 'blood enters through valve **O**'. Surprisingly few described the structure of pocket valves or atrioventricular valves or the way in which these valves block the backflow of blood. Some candidates stated that the labelled valves (**N** and **O**) worked antagonistically. Some who understood the principle of valve action failed to gain credit because they referred to the heart contracting and relaxing; others described the valves themselves as contracting and relaxing.

(d) Although many knew that semi-lunar valves are found in veins, common errors included liver, kidney, lungs, throat, trachea, arteries, capillaries, heart, and legs.

Question 5

The topic of human reproduction was generally well understood although common misconceptions regarding fertility and artificial insemination were evident.

(a) Only the strongest candidates were able to obtain full credit for this question. In a few scripts it was unclear as to whether the response given was **E** or **F**, but very few got this question completely wrong.

(b) These differences were generally well known and well described. A common error was to describe the male gamete as containing both X and Y chromosomes, without any consideration for the haploid state of these cells. A few candidates did not read the question carefully and described where gametes are made or the involvement of sex hormones. A large number mentioned the presence/absence of mitochondria as a difference which is not valid as both contain mitochondria. All expected responses were seen. Actual sizes were sometimes wildly inaccurate.

(c) (i) This question was not answered well. There was much confusion regarding which hormones are used in fertility treatments and their role in the menstrual cycle. Quite a few candidates mentioned FSH and LH, but were uncertain about how they work. Some described stimulation of follicles and/or ovulation in very vague ways; others referred to the 'release of ovaries'. Many candidates referred to egg production instead of ovulation. A few confused fertility treatment with birth control and/or contraception. A large number referred to oestrogen, progesterone and the endometrium.

(ii) A common misconception was to describe *in vitro* fertilisation (IVF) rather than artificial insemination (AI). Most candidates thought that only donor sperm are used. The way in which sperm is transferred was often poorly described, (e.g. into the female, into the reproductive system, into the egg).

Question 6

Only the most able candidates were able to apply their knowledge correctly throughout the question, with many showing a good understanding of some concepts but not others.

(a) Many candidates were unable to name the processes in the nitrogen cycle correctly, with many knowing the terminology but not attributing it to the correct process. Very few identified protein synthesis, incorrectly calling it 'assimilation' or 'deamination' instead. Stages **T** and **U** were usually identified correctly even if the other processes were given incorrectly. Some named the bacteria involved rather than the processes for **P**, **T** and **U**.

(b) Some candidates interpreted and thus described the results in Table 6.2 correctly, although many did not give enough detail to achieve full credit. A significant number compared the results at 45 days, instead of referring to the changes over 45 days. Some referred to the plants, rather than the nodules, gaining mass. Units were often missed from the data quoted for dry mass.

(c) The link to mutations was missed by many candidates, but the more able candidates were able to name and describe this phenomenon correctly. Despite stating that irradiation increased growth in part **(b)**, many candidates still made reference to 'bad' effects of radiation and mutation. Many candidates also restated their answer to part **(b)**.

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(d) Candidates who were well prepared were able to describe selective breeding in considerable detail, but others seemed to be unsure of the process. Many understood that plants with 'wanted features' were used and bred together, but could not then describe the later stages of selective breeding. A few confused selective breeding with natural selection and others described genetic engineering. The method of pollination was not usually mentioned.

(e) Many candidates who identified genetic engineering were unable to give any further suitable detail. Few stated that genes are transferred from one species to another but just copied out information from the question instead.

(f) Many candidates were unable to apply their knowledge and write sufficiently focused answers to obtain full credit. Several candidates stated that legumes added nitrate ions to the soil, without mentioning decay or nitrogen fixation. Others wrote about maize/legume hybrids and cross-pollination. A number thought that this question was about the advantages and disadvantages of a monoculture.

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BIOLOGY

Paper 0610/33
Extended Theory

Key Messages

1. Before starting to answer a question candidates should read through the whole of the question in order to decide what is required in each part. Candidates who fail to do this often repeat the same ideas in several parts of the question.

2. Candidates should be advised not to rewrite the question before starting their answer. Candidates who do this often run out of space and do not give the required number of points in their answer.

3. If it is necessary to continue an answer on a blank page or on a supplementary sheet candidates should indicate that there is a continuation and its location.

4. Candidates should take great care over the spelling of terms or names of structures or functions. Examiners will always reward phonetic spellings so long as there is no confusion with another term that candidates should know from the syllabus.

5. Where a candidate wishes to change an answer they should be advised to cross out the original answer clearly and write the new answer above, below or at the side of the original answer. This is especially important where letters or data values are required in an answer.

6. Care should be taken with teaching detailed information that goes beyond the requirements of the syllabus. A few candidates wrote about transamination in **Question 4(b)** confusing it with protein synthesis.

General comments

Many candidates appeared to find **Question 2**, on the eye, very difficult; there were quite a few scripts where candidates had not attempted some parts or even the entire question.

Candidates did not always make good use of technical terms, and used vague language, resulting in answers that were not clear. Many wrote about 'immunity' to pesticides in **Question 1(e)(ii)**, so a very high proportion did not gain credit here for the idea that the grasshoppers may be *resistant* to pesticides. As the idea of immunity is covered in ***Section II*** of the syllabus and antibiotic resistance in ***Section III***, the Examiners expect candidates to know how to differentiate between resistance and immunity.

Some candidates did not read the question carefully and lost credit due to missing important information. This was particularly noticeable in **Question 6** where candidates did not seem to realise that the bacteria produce lipase.

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Comments on specific questions

Question 1

This question covered aspects of ***Section I*** and ***Section IV*** of the syllabus. Candidates of all abilities used the key in Fig. 1.2 successfully and many were able to translate the information in the graph (Fig. 1.3) into prose. They were less successful at using their biological knowledge to explain the different effects of a pesticide and an agent of biological control in part **(e)(ii)**.

(a) The features visible in Fig. 1.1 that show that the goliath beetle is an arthropod are its jointed legs and its exoskeleton. Many candidates identified at least one of these features.

(b) Almost all candidates used the key to identify the seven arthropod pest species of date palms.

(c) The command word *outline* should have prompted a number of different damaging effects and candidates identified a range of these, particularly the risk of pesticides entering bodies of water and the effect that they may have on other species. More able candidates referred to the effects on non-target or harmless species, and to the idea that pesticides may become concentrated in the body tissues of animals in food chains. There were very few answers that discussed the consequences of this for top predators such as local extinction and egg shell thinning. Health hazards were mentioned. The effect of spray drift on people living near fields sprayed with pesticide was mentioned by a few.

(d) There were some good ideas to account for the inclusion of the unsprayed field in the study. The simplest acceptable answer was to say that it is a control. Better answers explained that this would show what would happen to the numbers of grasshoppers if no agent (pesticide or fungal spores) were sprayed on the field, and this would allow valid comparisons.

(e) (i) There were many good answers that described the effects very clearly. Data quotes were not always accurate. In each case the Examiners looked for the population density on a given day. Many, however, did choose appropriate figures to illustrate their answers.

(ii) Many candidates repeated their descriptions from **(i)**. Candidates who gained credit here stated that the pesticide killed grasshoppers immediately and then gave some explanation as to why the numbers recovered. Ideas included resistance of some grasshoppers to the pesticide, migration of grasshoppers from neighbouring areas and reproduction. The latter explanation was only likely if some grasshoppers hatched from eggs during the study period which was quite short, however, the Examiners allowed reproduction as a possible explanation. Some candidates also stated that the pesticide would not remain in the area for very long after spraying. In contrast, candidates had more difficulty explaining the effect of the fungal spores; only a few candidates realised that the spores would take time to grow within the grasshoppers, which explains the delayed effect shown in Fig. 1.3. The most able candidates explained the low numbers at the end of the study as being due to transmission of fungal spores from grasshopper to grasshopper.

Question 2

This question proved difficult for many candidates who appeared to know little about the eye. Quite a large number did not attempt part **(b)(ii)**.

(a) Candidates who realised that this question was testing their knowledge of cell structure scored well. Those who thought that the structures were in some way specialised for rods and cones struggled to find appropriate labels. **A** had to be labelled as *cell membrane* rather than just 'membrane'.

(b) (i) Many candidates knew that rods and cones are found in the retina. Incorrect answers included other parts of the eye such as the sclera.

(ii) This proved to be much more difficult and many did not attempt to answer. The Examiners accepted a variety of alternative terms for fovea and blind spot, but many candidates had clearly guessed the answer. The syllabus makes it clear that candidates should know the distribution of these two photoreceptors in the eye.

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(c) There were some excellent answers to this question on the functioning of rods and cones. Again, it appeared as if some candidates did not have the detailed knowledge to offer much of a suggestion as to how these two receptors function. Successful candidates stated that rods are sensitive to light of low intensity while cones are sensitive to light of high intensity and also 'detect colour'. Some candidates lost credit here by stating the direct opposite. Few candidates described the action of these receptors in converting light energy into electrical impulses that travel to the brain. Some knew the term *transducer* and gained credit.

Question 3

Part **(c)(ii)** proved to be the most difficult question on the paper.

(a) Explanations of the advantages of carbon dioxide enrichment were not very well structured. Candidates who began by stating that carbon dioxide is required for photosynthesis, or is a raw material for the process, were more likely to offer a better explanation. Better answers referred to carbon dioxide *concentration* as an important limiting factor of photosynthesis, and that boosting the concentration often increases the rate of photosynthesis unless there is another important limiting factor. Candidates could also say that enrichment prevents the concentration falling below that of the atmosphere as it might do if plants in the glasshouse are growing in high light intensity and a warm temperature.

(b) Many candidates appeared not to understand the point of this question. Those who looked carefully at Fig. 3.1 noticed that the concentration of carbon dioxide in glasshouse **E** was much higher than the concentration in the atmosphere outside. This would mean that carbon dioxide would diffuse out of the glasshouse and be wasted. As far as the grower is concerned this might not matter if the extra production by the plants offsets the cost of maintaining the enrichment.

(c) (i) This part tested candidates' knowledge of gas exchange in plants; at night there is no photosynthesis, but respiration continues so the concentration of carbon dioxide in the glasshouse will increase.

(ii) There are a variety of reasons for ventilating the glasshouse and candidates who considered some of these gained credit here. Some simply stated that opening the windows allows carbon dioxide to enter and oxygen to leave. The Examiners only awarded credit for these statements if they were linked to the appropriate time of day, which was the cue provided by part **(i)**. Ventilation allows some control of the temperature inside the glasshouse so it does not become too hot and allows water vapour to escape so that the air does not become too humid. High humidity favours the spread of plant diseases.

Question 4

Functions of the liver appear in a variety of places in the syllabus. This question linked together aspects of the circulatory system, the metabolism of amino acids, the control of blood glucose concentration, homeostasis and the mechanical and chemical digestion of fat.

(a) Many candidates answered this correctly, although **P Q R** was a not uncommon answer which possibly indicates misreading of the question. The introduction to Table 4.1 makes it clear that the question refers to concentrations in the blood as a meal is absorbed.

(b) Some candidates gave very confident answers describing the role of the liver in metabolising amino acids. They described deamination accurately and stated that urea is produced. There were fewer descriptions of the use of amino acids in protein synthesis *within* the liver. Candidates should know that a variety of proteins are made in liver cells, for example some that are involved in blood clotting. Some gave the term transamination thinking that it meant protein synthesis.

(c) It was relatively easy for candidates to gain full credit for this question if they knew about the antagonistic actions of insulin and adrenaline in stimulating the liver cells.

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(i),(ii) Many were able to state that insulin promotes glycogen synthesis and adrenaline stimulates glycogen breakdown. Candidates should also refer to the effect on moving glucose across the cell membranes of liver cells. Insulin promotes uptake and adrenaline promotes release of glucose into the blood. Candidates should not write statements that imply that these two hormones (and glucagon) act as enzymes in forming glycogen and breaking it down.

(iii) This part was answered well by some candidates who referred to fatty liver, cirrhosis and liver cancer. Vague answers, such as 'fat kills cells' did not gain any credit.

(d) This question proved to be a challenge. Candidates had first to recall how bile is involved in fat digestion and then work out what would happen if bile did not reach the duodenum. Very few stated that bile contains bile salts that emulsify fats. If they had recalled this (from the core syllabus) then they should have realised that emulsification would not happen and fats would remain as large globules. This would mean that the enzyme lipase would only be able to act on fat at the edge of these large globules, so slowing down the *chemical* digestion of fat. Very few explained that bile is involved in *mechanical* digestion and thus in its absence the rate of chemical digestion is very slow. The Examiners gave credit for any consequences of this such as poor absorption of fat, poor assimilation of fat and the high fat content of faeces. Many thought that without emulsification the fat in the diet would be trapped in the liver.

Question 5

This question on human reproduction included some information about artificial insemination (AI) The Examiners have noticed in papers in recent sessions that candidates often confuse AI with *in vitro* fertilisation (IVF). The syllabus does not include anything on IVF.

(a) Candidates who divided the actual length of the scale bar (35 mm) by 0.14 mm would have calculated the magnification as ×250. The Examiners allowed some leeway here accepting measurements between 34 mm and 36 mm to give answers between ×243 and ×257. Many candidates did not know how to carry out this type of calculation. Credit was awarded to those who knew that the actual length (0.14 mm) is the denominator in the calculation even if they measured something other than the scale bar or measured in centimetres and did not multiply their measurement by 10 before dividing by 0.14.

(b) There were many good answers to this question on *structural* differences between an egg cell and a sperm cell. Many thought that the 'jelly coat' and the follicle cells were part of the egg cell even though it is made clear by the labelling in Fig. 5.1 that they are not. The Examiners did not credit differences in size or numbers produced as the question specifically asked for structural features.

(c) Reduction in chromosome number from diploid to haploid is an important feature of meiosis that candidates should know from ***Section III*** of the syllabus. Many answered this question in terms of human chromosome numbers, which was perfectly acceptable especially as the whole of the rest of the question was set in the context of human reproduction. Many did not continue the argument to state that at fertilisation the diploid number is restored and that meiosis ensures that the chromosome number does not double with each generation.

(d) There are many reasons why men and women may be infertile. The Examiners credited a wide range of suggestions that included the mechanical (blocked oviducts, defective sperm), the chemical (hormone imbalance) and the intentional (vasectomy, tube ligation). This proved to be a high scoring question.

(e) Many candidates struggled to explain why sperm are placed in the uterus near the time of ovulation. Those who described what happens at ovulation were often more successful at explaining that the ovum moves along the oviduct, so would be present just before or just after sperm would be placed in the uterus. They explained that this would be more likely to ensure that fertilisation occurs. They also explained that both eggs and sperm only survive for a short period of time. Some candidates explained why it is important to place the sperm in the uterus rather than in the more hostile environment of the vagina.

(f) There were some good answers to this question on the reasons for the secretion of progesterone after ovulation. Many stated that progesterone maintains the endometrium, which was often described as the lining of the uterus. The advantages of this was often explained in terms of

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implantation. Another line of reasoning involves inhibiting the secretion of FSH and the development of another follicle.

(g) Many candidates gave rather vague responses to this question. Some, however, wrote out an equation making it clear that the number of women who had become pregnant following AI should be expressed as a percentage of those who had received this treatment for infertility.

Question 6

(a) Answers that dealt with disposal of waste paper in landfill sites were not credited. The question specified disposal by burning, for example in incinerators or combined heat and power plants that convert waste into electricity and heat for buildings. Candidates concentrated on reduction in the use of trees for making paper and therefore the reduction in deforestation. They also explained that there would be less carbon dioxide released as the result of not burning the paper which frequently led onto a discussion of the greenhouse effect and global warming. It should be pointed out that recycling paper uses energy that also generates carbon dioxide, although the energy involved in recycling is less than that used in producing paper from trees.

(b) Some candidates saw that this question on the use of bacteria used in the Indian study to investigate the removal of ink from paper pulp was testing aspects of growth of microorganisms (from ***Section IV***) and the secretion of enzymes (***Section II***). Candidates who gained credit here referred to the growth of the bacteria so that they would continue to secrete lipase. This activity would maintain a higher concentration of lipase than that in the mixture which only contained a solution of lipase. Over time it is likely that lipase molecules become less effective. However, candidates should have realised that the bacteria could divide so they could increase the concentration of lipase.

(c) This proved to be an easy question as many candidates used their knowledge of enzyme activity from ***Section II*** to explain that at high temperatures enzymes are denatured. It is also likely that the bacteria will die and so will not secrete any lipase.

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BIOLOGY

Paper 0610/04
Coursework

General comments

The number of Centres entering candidates for the Coursework component continues to grow. While many new Centres were entirely successful in assessing their candidates' practical skills appropriately, a few need to review their tasks, mark schemes and marking to ensure that their marks are valid, and comparable with those of other Centres.

The choice of suitable tasks is very important. The tasks must allow candidates to demonstrate all aspects of the skill (or skills) that are being assessed. For example, for C3, there must be opportunity to process results, to draw conclusions and to recognise significant sources of experimental error. For C4, there must be a need to recognise and control important variables, which means that the task must involve the investigation of the effect of one variable (the independent variable) on another (the dependent variable). Tasks that simply involve the routine application of a particular technique do not allow access to this component of the assessment. For example, identifying the substances present in a mix of food substances, using food tests, is not an appropriate task, because there is no need to control variables, and little or no opportunity for suggesting improvements.

Centres are reminded that purely paper-and-pencil exercises are also not appropriate. Paper 4 assesses practical skills, and all tasks must involve candidates actively in the collection of data. For C4, candidates must actually do the experiment that they have planned.

It is important that copies of all instructions given to the candidates, whether written or oral, are included with the coursework sample. The Moderators need to know exactly what candidates were asked to do, and how much guidance they were given. Some Centres include a brief explanation of the context within which the task was done, outlining what had already been covered in class before the task was set. This is very helpful.

The construction of mark schemes is also most important. Each task should have a specific mark scheme for each skill that is assessed. This mark scheme should be based on the generic criteria, which are included in the syllabus document. Each strand of these criteria should be rewritten so that it is task-specific. For example, for a C4 task, the generic criteria about controlling variables should be rewritten to include statements about precisely which variables should be controlled.

Most Centres choose to write their mark schemes in a similar way to the generic criteria, and this generally works very well. Some prefer to distil these criteria into a series of checking points. This can also be appropriate, but great care is needed in the construction of a check-list scheme. In particular, it is important to ensure that every aspect of the generic criteria is covered by the check points, and also that each check point relates to a particular Level – 2, 4 or 6. The mark that the candidate is awarded is **not** determined simply by adding up the number of ticks that the candidate is given, but rather by the overall level of performance, judged by the match of this performance against the criteria for each level.

If tasks and mark schemes are well chosen and constructed, then the assessment generally falls into place with few problems. It is always helpful if the teacher making the assessment writes full comments on each piece of work, indicating where there are errors or omissions, and where success has been achieved. This not only provides invaluable feedback to the candidate, but also helps the external Moderators to understand how and why a particular mark has been awarded. Each piece of work should have the skill assessed, and the mark awarded, indicated very clearly on it.

If more than one teacher has been involved in the assessment of practical skills, then it is very important that internal moderation is undertaken, to ensure that the standards applied for all candidates are comparable. This is made easier where all candidates do the same tasks, and the same mark schemes are used. It is acceptable to use different tasks, but this will require considerably more effort to be made to ensure that

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marks for one teaching group can be compared directly with those of another. It is best if just one teacher takes on the role of internal Moderator, as this is the only way to ensure that the same standards have been applied for the entire entry from one Centre. The external Moderators cannot change the rank order within a Centre; it is the Centre's responsibility to ensure that this is correct.

Where internal moderation has resulted in the change of a mark, this should be shown clearly on the work itself, as well as on the Individual Candidate Record Card. This allows the external Moderators to see the actual mark that was eventually awarded for a particular skill on a particular piece of work, which is essential for them to be able to make a judgement about whether or not marks should be changed further.

The choice of Paper 4 opens up numerous possibilities for Centres to choose interesting, novel and locally-relevant practical activities for their candidates, and it is encouraging to see wide use of this freedom. Some tasks recur frequently, because they are central to the syllabus material and readily allow access to all the components of several skills – for example experiments investigating the effect of various factors on enzyme activity, rate of photosynthesis, rate of transpiration or heart rate. But it is good to see many Centres putting these and other tasks into an interesting context for candidates, often setting a challenge that has clearly stimulated many candidates to do their very best work.

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BIOLOGY

Paper 0610/51
Practical Test

Key Comments

It is always important that candidates read the questions very carefully before starting to answer.

There were two questions involving a number of the Practical C skills. Overall candidates were generally well prepared to answer the questions.

General Comments

The standard of English was good and the presentation of answers showed a reasonable understanding of the questions. Overall, candidates achieved the complete range of available credit. Most candidates showed that they had adequate time to complete both questions.

It is important that candidates use a good, sharp HB pencil for clarity and accuracy in drawings and graphs. This also ensures that errors can be carefully and thoroughly erased. If a drawing is made using ink, any corrections may be difficult to achieve neatly.

Comments on specific questions

Question 1

(a) (i) The differences in appearance between the outer and inner surfaces of the strips were described by the candidates. This exercise was intended to direct candidates to observe the two surfaces for the descriptions in the investigations that follow. Most differences were based on colour or texture.

(ii) After ten minutes the pieces of leaf were observed and the appearance of one 'end' of each strip was recorded by means of a drawing to complete Table 1.1.

It was expected that the end of each piece of leaf would be drawn and the two surfaces of the leaf labelled or otherwise indicated to show the difference in curvature between the inner and outer surfaces. Very few candidates attempted to indicate these differences. Various interpretations of the term 'end' were seen and these were accounted for in the marking.

Most candidates illustrated all four pieces showing that the instructions to set up the investigation had been followed carefully, and with careful scrutiny it was usually possible to distinguish the changes due to the different external conditions.

(iii) After removing the pieces of leaf from the water and the 10% salt solution, candidates were asked to feel the two pieces and describe the difference between these pieces. Most candidates described a change in the texture. The piece of leaf in the 10% salt solution was usually described as 'slimy' or 'sticky', whereas the piece from the water was 'firm' or 'harder'. Some differences were based on colour.

An explanation was required to account for the differences and most candidates mentioned that osmosis was involved. The movement of water was noted, with the direction into the piece of leaf (in water) or out of the piece of leaf (in 10% salt solution). Able candidates referred to the water potential differences.

(iv) Candidates were required to explain how a 2.5% salt solution might be prepared using the 5% salt solution. As there were two different concentrations of salt solution available for the dilution (5%

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and 10% salt solutions), it was necessary for candidates to identify which one was used as the starting point. Many candidates did not specify which salt solution was used for the dilution to prepare the 2.5% solution and several candidates found the dilution process difficult to explain.

(v) The main source of error that was noted by most candidates referred to the lack of precise measurement of the volume of water used with the 10% salt solution. The suggested improvements involved the use of a named piece of equipment, e.g. burette, pipette, or measuring cylinder to enable a precisely measured volume to be made rather than an approximation.

(b) (i) The slight darkening of the piece of leaf in the iodine solution was interpreted by some as indicating the presence of starch. However, the characteristic blue-black colouration should not have been observed as starch is not present in notable quantities in the sections of the leaves used.

(ii)(iii) Many candidates described the biuret test correctly and a few referred to an appropriate safety feature. Some of the weaker candidates incorrectly described the Benedict's test for reducing sugars, possibly confused by the reference in the question to hot water being available.

The piece of leaf darkened in the biuret reagent and this colour change led candidates to the conclusion that protein was present. There is a minute quantity of protein present in all leaves but it is doubtful that this would show as a purple colour change, even if the chlorophyll were removed.

(c) It was hoped that the measurement would be given in millimetres, however, many candidates measured the diameter in centimetres, and others did not give any unit of measurement. It is important that all measurements are made in metric (SI) units. Some candidates gave the external diameter, while others measured the internal diameter. As the actual diameter was not specified in the introduction to this question, all diameters were considered within a given range. A few candidates drew a line on Fig. 1.3 to indicate where the diameter had been measured. This is good practice and should be encouraged.

The magnification formula used should have been the diameter of the leaf section in Fig. 1.3, divided by the actual given diameter, 55 mm, this could only be calculated correctly if the same units were used to measure both diameters, which required conversion of cm to mm or vice versa. Magnification does not have a unit, however, a number of candidates recorded the calculated magnification followed by a unit of measurement.

Question 2

This question was based on three arthropods shown in Fig. 2.1.

(a) (i) Specimen **A** was correctly selected by the vast majority of candidates.

(ii) One visible feature described by most candidates was the presence of the large claws, (or other similar name), easily observable in **A**. Other features frequently mentioned included the long antennae, the fanned tail, the cephalothorax or the many pairs of legs. One negative feature commonly mentioned, based on comparison with **B** and **C**, was the absence of wings. Some candidates mentioned the hardness of the exoskeleton, but it is impossible to determine this from observation of Fig. 2.1 alone.

(iii) Most candidates correctly named the group to which **B** and **C** belong as insects. A number of other groups were suggested, including annelids, worms, molluscs and some vertebrate groups.

(b) There were a number of structures to be accurately presented in proportion to one another and many candidates demonstrated a good level of drawing skill.

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(c) (i) There was considerable variation between the measurements given by candidates.

(ii) There were many different answers seen based on the individual measurements of the five larvae in **(c)(i).**

(iii) Using the frequencies from Table 2.2, candidates were required to plot a histogram showing the frequency of each range of lengths. This was achieved by many candidates using a suitable and even scale to fill more than half of the printed grid. However, the axes were often incompletely labelled. The headings in Table 2.2 should have been used as axis labels and each bar should have been labelled to show the range of length and the unit of measurement. The columns should have been of equal width and touching one another. There was no need to shade in the columns but it was important that rulers were used for the sides of the bars rather than drawing them freehand.

A few candidates incorrectly presented a line graph despite having been asked to construct a histogram. Some candidates used scales that were too small.

(iv) Candidates were asked to comment on the shape of the histogram. References to the age, food supply or natural variation were amongst ideas that were considered.

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BIOLOGY

Paper 0610/52
Practical Test

Key Messages

This paper gave candidates the chance to convey practical observations in different ways. It was essential that answers were precise. Descriptions, drawings, labels, graphs and tables all needed to be unambiguous. Vague statements and lines that were not sharp and clear could not be given full credit.

General Comments

Candidates benefitted if they had a basic understanding of general science, especially in **Question 1**.

In **Question 1**, candidates were required to compare the cooling rate of water in two test-tubes, one wrapped in two layers of paper towel and the other left uncovered. To do this the candidates had to be able to use and read a thermometer and time intervals of two minutes. The candidates' results had to be recorded in a table from which a line graph for both sets of data was drawn and then interpreted.

Question 2 examined candidates' ability to investigate the structure of a flower related to its means of pollination.

The use of sharp HB pencils and clean erasers was helpful here as mistakes in lightly drawn clear lines could be altered if necessary, whereas errors in graphs and drawings made in ink could not be corrected. Crossed out lines looked messy and spoiled the clear outline.

Overall more candidates received full credit for **Question 2** than for **Question 1**. In both questions there was a wide range of difficulty, and more answers than usual gained full credit.

Comments on Specific Questions

Question 1

(a) (i) Almost all candidates made a neatly ruled grid with headings showing temperature in °C for tube **A** and tube **B**, and the times in minutes. Some candidates wrote the units in every cell of the grid. This is not good practice because it results in an unnecessarily cluttered table.

(ii) Almost all candidates completed the recording of the temperature of the water in each tube, again at two minute intervals, and entered their data into the table. The vast majority showed a drop in temperature for both tubes.

(iii) There were many excellent, well-constructed graphs. Most graphs filled the printed grid and were accurately plotted. Some candidates forgot to label the axes with the time in minutes along the *x*-axis and the temperature in °C along the *y*-axis. A very few candidates got the axes the wrong way round or extended the lines beyond the 10 minute point for which no data was collected. Very few candidates neglected to identify the lines for tube **A** and tube **B**. Some candidates labelled the lines, while others used different symbols for the points or used different colours or styles for the lines. A small proportion of the candidates made histograms instead of line graphs.

Many candidates chose a difficult scale, for example where 10 °C was represented by seven or 15 small squares on the grid. Although such a scale could be organised to fill the grid, it was difficult to plot the points accurately.

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Candidates should be reminded that an axis does not have to begin at zero. If the axis only covers the range of the data, it is still possible to fill the grid by using a larger scale. The shape of the line then becomes easier to see. For this question where there were two sets of data to be plotted using the same axes, the important difference between these lines was clearer with a large scale.

For drawing graphs, a sharp HB pencil and a clean eraser are a great help. Some candidates drew ink lines or thick, heavy pencil lines that could not be corrected. A few candidates tried to draw a line of best fit which should have had approximately the same number of points on each side of the line.

(b) Most candidates' data showed that the temperature of the water in the unwrapped tube fell faster than that of the water in the wrapped tube. Some candidates, expecting that to be the result, described it even though there was little difference in the slope of the lines on their graphs. Candidates should describe their data, not that which was expected (unless specifically asked for this in the question).

Very few candidates realised that it was the air trapped between the layers of paper that was the bad conductor of heat which insulated the tube. Candidates with little understanding of heat energy had difficulty in expressing the idea of reduced or slower heat loss to the surroundings, so their answers were imprecise. Other candidates suggested that heat was lost through the paper by evaporation or convection.

(c) There were plenty of well thought-out answers here. Most candidates could see that transferring the thermometer from one tube to the other, also transferred heat and water, and that it increased the time interval between taking temperatures as it was necessary to allow time for the changed temperature to be registered on the thermometer. The improvement was to have a thermometer in each tube, held by a clamp, and maybe even for two candidates to read the two thermometers at precisely the same time. Another answer was to use digital thermometers or data loggers. If the fall in temperature in the two tubes was recorded in the same order, **A** first followed by **B**, the effect on the time interval would be decreased.

Another frequent suggestion was to measure the volume of hot water used in each test-tube with a measuring cylinder, pipette or burette instead of relying on the position of the labels 2 cm from the top of the test-tubes to indicate volume. Candidates should be reminded that statements about "the amount of water" are imprecise and that "amount" should in this case be replaced with "volume".

Some candidates wrote about the conditions in the room. The essential point for the source of an error was any *change* in conditions. Draughts, air currents from air conditioning or from open windows were mentioned by some candidates.

Candidates sometimes suggested doing the experiment with tube **A** by itself and then repeating the experiment using tube **B**. In order for this to be valid, it would be important to control all other variables, such as using the same apparatus, starting with water of the same temperature and having the same room temperature. Almost none of the candidates who suggested doing the experiment twice, once with tube **A** and once with tube **B**, explained how they would make sure that the two were genuinely comparable by having the same conditions.

Repetition because of personal errors in reading the thermometer and use of different materials were not errors arising from the method so were not valid answers.

(d) Most candidates knew that the final temperature of the water in the two tubes left for an hour in a room at 25 °C would be the same. Some candidates expected that the temperature of the water in the wrapped test-tube would still be higher than in the other test-tube. A small number of candidates predicted that the temperature of the water would be lower than the room temperature.

A few candidates calculated the final temperature based on the rate of cooling of their own tubes even though they did not know the background temperature of the room in which they worked.

Practical work using thermometers to measure water temperature would help candidates to become familiar with the concept of heat transfer.

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(e) Many candidates could not recognise structures in the section through mammalian skin. Sometimes labelling lines stopped short of the structure they were intended to label. The ends of labelling lines should touch the structures labelled so that the meaning is clear. Arrows at either end of labelling lines are confusing and are not advised.

A few candidates failed to follow the rubric and labelled the photograph in Fig. 1.2 instead of the drawing which was Fig. 1.3.

(f) (i) The line **PQ** in Fig. 1.3 was almost always correctly measured, although a few candidates confused cm and mm.

(ii) The vast majority of candidates correctly calculated the magnification of Fig. 1.3 as ×20. They knew that the formula was length in the drawing divided by the actual length. Some candidates inverted the formula or multiplied the answer by 100.

(g) This was the question that was answered least well in this paper. It would seem that most candidates were unfamiliar with the use of anhydrous cobalt chloride paper which changes colour from blue to pink when water is present. Candidates who gave a chemical test more often suggested anhydrous copper sulfate, which would have shown if the sweat contained water. The grey-white anhydrous copper sulfate powder changes to blue when water is present.

A large number of candidates misread the question completely and wrote about the cooling effect of the evaporation of sweat from hot skin.

Question 2

(a) This was an easier question for most candidates. A small minority drew around a single petal only. To show the details some candidates added labels to the outlines of the petals. Other candidates made a written note of details, or drew the details in the shapes of the petals. Details included honey guides, colour or fringed margins of petals and little holes made by herbivores. Almost all candidates were awarded full credit.

(b) The quality of the drawings made for this question varied from excellent large, clear, detailed drawings, to indistinct rough sketches. Candidates need to be reminded that a large drawing should almost fill the space allowed. Sometimes a long length of stem was included, so that the reproductive structures were small.

Natural structures should not be drawn with a ruler. For example, although a style might look straight, it is better drawn carefully by hand then by using a ruler.

Biological drawings convey the information obtained by observations, so the detailed proportion and outline shape must be clear and not shaded, so that they show structures. Stippling may be used if it is necessary to distinguish areas.

The outline of the reproductive structures in this question was often spoilt by heavy shading of the stigma and anthers.

(c) Most candidates described the colour of the petals or the presence of honey guides. Candidates should remember that, in this context, colour and smell are attractive to insects which pollinate the flower. Descriptions such as “good smell” or “nice colour” were too vague.

(d) Most candidates had learned that the ovule becomes the seed and the ovary, the fruit. A common error was to confuse the term “ovule” with “ovum”.

(e) This question was not about one particular flower, but about how flowers generally are pollinated, and so features of pollen gained credit here. Most candidates had learned the differences between wind-pollinated and insect-pollinated flowers and gained full credit.

A few candidates confused lightness of pollen with lightness of the flowers. The flowers were described as being swept away by the wind.

A very small number of candidates confused pollination with seed dispersal.

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BIOLOGY

Paper 0610/53
Practical Test

Key Messages

This paper gave candidates the chance to convey practical observations in different ways. It was essential that answers were precise. Descriptions, drawings, labels, graphs and tables all needed to be unambiguous. Vague statements and lines that were not sharp and clear could not be given full credit.

General Comments

Candidates benefitted if they had a basic understanding of general science, especially in **Question 1**.

In **Question 1**, candidates were required to compare the cooling rate of water in two test-tubes, one wrapped in two layers of paper towel and the other left uncovered. To do this the candidates had to be able to use and read a thermometer and time intervals of two minutes. The candidates' results had to be recorded in a table from which a line graph for both sets of data was drawn and then interpreted.

Question 2 examined candidates' ability to investigate the structure of a flower related to its means of pollination.

The use of sharp HB pencils and clean erasers was helpful here as mistakes in lightly drawn clear lines could be altered if necessary, whereas errors in graphs and drawings made in ink could not be corrected. Crossed out lines looked messy and spoiled the clear outline.

Overall more candidates received full credit for **Question 2** than for **Question 1**. In both questions there was a wide range of difficulty, and more answers than usual gained full credit.

Comments on Specific Questions

Question 1

(a) (i) Almost all candidates made a neatly ruled grid with headings showing temperature in °C for tube **A** and tube **B**, and the times in minutes. Some candidates wrote the units in every cell of the grid. This is not good practice because it results in an unnecessarily cluttered table.

(ii) Almost all candidates completed the recording of the temperature of the water in each tube, again at two minute intervals, and entered their data into the table. The vast majority showed a drop in temperature for both tubes.

(iii) There were many excellent, well-constructed graphs. Most graphs filled the printed grid and were accurately plotted. Some candidates forgot to label the axes with the time in minutes along the *x*-axis and the temperature in °C along the *y*-axis. A very few candidates got the axes the wrong way round or extended the lines beyond the 10 minute point for which no data was collected. Very few candidates neglected to identify the lines for tube **A** and tube **B**. Some candidates labelled the lines, while others used different symbols for the points or used different colours or styles for the lines. A small proportion of the candidates made histograms instead of line graphs.

Many candidates chose a difficult scale, for example where 10 °C was represented by seven or 15 small squares on the grid. Although such a scale could be organised to fill the grid, it was difficult to plot the points accurately.

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Candidates should be reminded that an axis does not have to begin at zero. If the axis only covers the range of the data, it is still possible to fill the grid by using a larger scale. The shape of the line then becomes easier to see. For this question where there were two sets of data to be plotted using the same axes, the important difference between these lines was clearer with a large scale.

For drawing graphs, a sharp HB pencil and a clean eraser are a great help. Some candidates drew ink lines or thick, heavy pencil lines that could not be corrected. A few candidates tried to draw a line of best fit which should have had approximately the same number of points on each side of the line.

(b) Most candidates' data showed that the temperature of the water in the unwrapped tube fell faster than that of the water in the wrapped tube. Some candidates, expecting that to be the result, described it even though there was little difference in the slope of the lines on their graphs. Candidates should describe their data, not that which was expected (unless specifically asked for this in the question).

Very few candidates realised that it was the air trapped between the layers of paper that was the bad conductor of heat which insulated the tube. Candidates with little understanding of heat energy had difficulty in expressing the idea of reduced or slower heat loss to the surroundings, so their answers were imprecise. Other candidates suggested that heat was lost through the paper by evaporation or convection.

(c) There were plenty of well thought-out answers here. Most candidates could see that transferring the thermometer from one tube to the other, also transferred heat and water, and that it increased the time interval between taking temperatures as it was necessary to allow time for the changed temperature to be registered on the thermometer. The improvement was to have a thermometer in each tube, held by a clamp, and maybe even for two candidates to read the two thermometers at precisely the same time. Another answer was to use digital thermometers or data loggers. If the fall in temperature in the two tubes was recorded in the same order, **A** first followed by **B**, the effect on the time interval would be decreased.

Another frequent suggestion was to measure the volume of hot water used in each test-tube with a measuring cylinder, pipette or burette instead of relying on the position of the labels 2 cm from the top of the test-tubes to indicate volume. Candidates should be reminded that statements about "the amount of water" are imprecise and that "amount" should in this case be replaced with "volume".

Some candidates wrote about the conditions in the room. The essential point for the source of an error was any *change* in conditions. Draughts, air currents from air conditioning or from open windows were mentioned by some candidates.

Candidates sometimes suggested doing the experiment with tube **A** by itself and then repeating the experiment using tube **B**. In order for this to be valid, it would be important to control all other variables, such as using the same apparatus, starting with water of the same temperature and having the same room temperature. Almost none of the candidates who suggested doing the experiment twice, once with tube **A** and once with tube **B**, explained how they would make sure that the two were genuinely comparable by having the same conditions.

Repetition because of personal errors in reading the thermometer and use of different materials were not errors arising from the method so were not valid answers.

(d) Most candidates knew that the final temperature of the water in the two tubes left for an hour in a room at 25 °C would be the same. Some candidates expected that the temperature of the water in the wrapped test-tube would still be higher than in the other test-tube. A small number of candidates predicted that the temperature of the water would be lower than the room temperature.

A few candidates calculated the final temperature based on the rate of cooling of their own tubes even though they did not know the background temperature of the room in which they worked.

Practical work using thermometers to measure water temperature would help candidates to become familiar with the concept of heat transfer.

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(e) Many candidates could not recognise structures in the section through mammalian skin. Sometimes labelling lines stopped short of the structure they were intended to label. The ends of labelling lines should touch the structures labelled so that the meaning is clear. Arrows at either end of labelling lines are confusing and are not advised.

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BIOLOGY

Paper 0610/61
Alternative to Practical

Key Comments

It is always important that candidates read the questions very carefully before starting to answer.

There were two questions involving a number of the Practical C skills. Overall candidates were generally well prepared to answer the questions.

General Comments

The standard of English was good and the presentation of answers showed a reasonable understanding of the questions. Overall, candidates achieved the complete range of available credit. Most candidates showed that they had adequate time to complete both questions.

It is important that candidates use a good, sharp HB pencil for clarity and accuracy in drawings and graphs. This also ensures that errors can be carefully and thoroughly erased. If a drawing is made using ink, any corrections may be difficult to achieve neatly.

Comments on specific questions.

Question 1

(a) (i) The changes to the pieces of onion leaf involved ideas based on the process of osmosis involving the movement of water into the leaf piece that had been in water, or leaving the leaf piece that had been in salt solution. Many answers included the definition of osmosis and continued to relate the movement of water to the correct gradient expressed in terms of water comparison between the leaf piece and the external solution. Able candidates referred correctly to water potential differences.

Some mistaken explanations were incorrectly based on the salt moving; only the solvent, i.e. water, moves by this special diffusion process.

The piece of onion leaf in air was often overlooked in explanations, although a few candidates explained that the piece would dry out, losing water by transpiration or evaporation.

(ii) Suggestions for improvement had to relate to this investigation using onion leaves, and not another plant tissue. Ideas such as extending the time period beyond ten minutes, increasing the range of salt concentrations, determining the mass, or repeating the readings with leaves from the same plant were accepted as possible suggestions.

(b) (i) Some candidates correctly labelled a mesophyll cell using a line and the letter **A** as directed in the question, while others used the word 'mesophyll'. Sometimes a bracket was used to label the whole width of the mesophyll area. Cell **B**, a xylem vessel, was often labelled incorrectly in the vascular bundle at the bottom of the section with the label line extending into the group of small, tightly packed cells that are phloem. Any of the larger cells just below are xylem vessels. Cell **C**, an epidermal cell, was usually identified along the upper edge of the section, although cells on the lower edge were also chosen. If a line had not been used to indicate precisely which cell was labelled and the letter was written over several cells, credit could not be awarded as it was unclear as to which was the intended cell.

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(ii) The candidates needed to identify one stoma, of which there were three visible along the upper border of the section. The size of the circles drawn varied widely and circle which were too large could not be credited due to the lack of precision in the stoma identification.

(c) Some candidates showed exactly where they had chosen to measure the diameter by drawing a line across the section. This is good practice and should be encouraged. Others chose not to construct a line but simply to record a measurement of either the internal diameter of the central 'lumen', or the external diameter, at any angle across the section. It was expected that candidates would give the measurement in millimetres as this was the unit used in the actual diameter given in the question. Many chose to use centimetres, which was acceptable provided a factor of 10 was shown in the working so that the magnification could be correctly calculated. Very few candidates used imperial units this session. The syllabus states that SI units should be used.

Some candidates calculated percentages.

The magnification formula used should have been the diameter of the leaf section in Fig. 1.3, divided by the actual given diameter, 55 mm. The magnification should be expressed without units. A multiplication sign, ×, in front of the answer, or the word 'times' are all that is necessary.

(d) (i) Candidates were asked to describe how a piece of onion leaf could be safely tested for the presence of reducing sugars. This should involve the Benedict's test and heating using a hot water bath.

Most candidates referred to the correct test and included a safety feature relating to this test. There were a few candidates who mentioned other tests.

One common error was inadequate preparation of the leaf sample. A piece of leaf may float on the surface of the reagent and it is necessary to break open the cells to release the contents. This question required just the method and not the results, which were the basis for the next part of the question.

(ii) This is the part where the candidates had the opportunity to explain the results of the Benedict's test colour changes for three different solutions containing no reducing sugars, a low and a high concentration of reducing sugar. Most candidates' descriptions of the expected colour changes were clearly stated. A few answers referred only to the intensity of colour change and failed to describe the actual colours involved in this semi-quantitative test.

(e) Fig. 1.5 showed the four stages required to test a piece of green leaf for the presence of starch, using ethanol to remove the chlorophyll so that the colour change with the iodine solution would be clearly visible. Most candidates were able to correctly explain the reasons for the four stages shown in the separate diagrams. A few candidates did not attempt this question.

Question 2

(a) (i) Many candidates correctly identified the nematode worm, and gave the correct letter.

(ii) Candidates were required to give two reasons for their choice in **(a)(i)**. Most gave a negative reason, naming a structure present in two of the worms and missing from the nematode, such as the lack of segmentation. Very few candidates commented on the smooth outer surface. The magnification was noticed by some candidates and led to the idea that worm **C**, the nematode, was the smallest.

(iii) The name of the group to which worms **A** and **B** belong, was sometimes given correctly. There were a number of other invertebrate groups that were named in error, including insects.

(b) The quality of the drawings varied from excellent large, clear, detailed drawings, to indistinct rough sketches. Candidates need to be reminded that a large drawing should almost fill the space allowed. Biological drawings convey the information obtained by observation skills so accurate proportion and detailed outline shape must be clear and not shaded, so that as many structures as possible can be shown. Stippling or dots may be used if it is necessary to distinguish certain areas. Candidates should be reminded that a sharp HB pencil and a clean eraser should be used.

Many drawings lacked any labels.

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(c) (i) There was considerable variation between the measurements given by the candidates.

(ii) There were many variations seen based on the individual measurements of the five worms in **(c)(i).**

(iii) Using the frequencies from Table 2.2, candidates were required to plot a histogram showing the frequency of each range of lengths. This was successfully achieved by many candidates using a suitable scale to fill more than half of the printed grid. However, the axes were often incompletely labelled. The headings in Table 2.2 should have been used as axis labels and each bar should have been labelled to show the range of length and the unit of measurement. The columns should have been of equal width and touching one another. There was no need to shade in the columns but it was important that rulers were used for the sides of the bars rather than drawing them freehand.

A few candidates incorrectly presented a line graph despite having been asked to construct a histogram. Some candidates used scales that were too small.

(iv) Candidates were asked to comment on the shape of the histogram. References to the age, food supply or natural variation were amongst ideas that were considered.

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BIOLOGY

Paper 0610/62
Alternative to Practical

Key Messages

It is most important that candidates read through questions carefully to understand what is required.

Candidates should apply scientific understanding, precision and terminology in their answers.

Candidates need more guidance in planning investigations and this would result in an improvement in the marks for candidates of all abilities.

General comments

The standard of English was good and the presentation of answers showed a reasonable understanding of the questions. Overall, the paper produced a complete range of marks. Most candidates showed that they had adequate time to finish the paper.

In **1(c)(ii)** candidates were asked to describe an experiment to test a hypothesis about enzymes. Many candidates only gave an outline and did not describe any practical procedure or give any expected results to explain how the hypothesis could be tested.

In **2(a)** candidates' outline diagrams showed less shading than in past examinations, but the diagrams were very inaccurate in proportion and details. Many drawings did not resemble the specimen illustrated in Fig. 2.1. In particular, the drawings of the mouthparts were very variable. Much more practice is needed; candidates need to be trained how to make more careful observations in order to produce drawings which are a more accurate representation of the specimen.

In **2(c)(i)** the practical procedures involved in food testing were well known and described accurately.

In **3(b)** many candidates made accurate measurements and successfully calculated the actual length of the pollen grain.

Comments on specific questions

Question 1

The first part of this question was based on an experiment to investigate the effects of lemon juice on the activity of an enzyme found in apple cells. This enzyme is a catalyst for the reaction which oxidises the colourless compounds in apple tissue converting these chemicals to coloured compounds.

(a) Most candidates were aware that the change of colour of the litmus paper showed lemon juice to be acidic. A small number were confused between low and high pH, and a few stated that the lemon juice was alkaline. Weaker candidates incorrectly gave answers referring to the oxidation process, rusting or suggested that it was a positive result with Benedict's solution.

(b) Most candidates correctly described the differences between the appearances of the cut surfaces of the apple pieces in dish **1** and dish **2**.

(c) (i) Many candidates answered this clearly and succinctly, correctly linking the acid in lemon juice to the lack of browning, and hence inactivity of the enzyme. The idea that the enzyme had been denatured was quite well understood and a small number of able candidates gave descriptions of the damage to the active site of the enzyme. There were, however, some candidates who,

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incorrectly, said that the enzyme had been killed. Enzymes are not living organisms. Enzymes are biological molecules that catalyse reactions and therefore enzymes can be destroyed but not killed. Quite a large number of candidates failed to make the link with the acid in the lemon juice and so they were only able to gain credit for the colour change. Some of these candidates explained about the activity of the enzyme in water and the oxidation process, and then incorrectly tried to link the failure to change colour with the idea that the lemon juice prevented oxygen reaching the apple.

(ii) The question stated 'this colour change' and so it was expected that the candidates' experiments would use apple. Many candidates incorrectly described experiments using different food substances or enzymes, e.g. those in washing powder. Having made the link between pH and enzyme activity, it was expected that candidates would describe an experiment which looked at the effect of temperature on enzyme activity.

This question was not well answered. Only a small number of more able candidates gave a complete method with expected results and an explanation that linked their result to enzyme activity. These candidates gave specific temperatures at the extremes, or conditions which would prevent an enzyme from functioning, e.g. boiling or placing in a refrigerator They then described the results that would be expected, linking these results to enzyme activity, e.g. boiling denatures enzymes and so there would be no colour change.

Many answers were incomplete, candidates simply stating that the apple should be placed in a range of different temperatures, without giving any examples. A common error was to choose a range of temperatures that would all give a colour change. Temperatures over 50 °C or below 5 °C would be needed to prevent colouring and show the effect on enzymes.

Other candidates did correctly identify suitable temperatures or conditions but then stated that the results should be observed rather than describing any expected results. Finally, there were some who failed to give any explanation as to why their expected results would link to enzyme activity.

(d) (i) Answers describing the colour difference at the end of 20 minutes, or for any stated time period, were accepted. To explain the idea of a quicker reaction, descriptions of an immediate colour change for the cut surface were accepted. Able candidates gained full credit here. Overall, however, it was not answered well and the most common error was for candidates to simply repeat the colour changes as given in the results table without drawing out any differences. A small number of candidates incorrectly described differences in appearance as being either rough or smooth.

(ii) Many candidates realised that breaking apples may cause less damage to cells or that it could release less contents. Better candidates went further and explained that it was possible that the cells were separated rather than cut open. Weaker candidates only gave answers about the knife cutting cells without comparing it to breaking the piece of apple. A small number of candidates incorrectly tried to link the browning of the cut apple with the knife, stating that the knife was causing an oxidation or rusting reaction on the surface of the apple.

Question 2

(a) Overall, the way in which the head was drawn was acceptable but, considering that there was only one specimen to look at, there were many different interpretations of what the head looked like and the head structure was shown from a number of different angles. Candidates should represent the orientation, features and proportions accurately. The objective is to produce diagrams which are true representations of what the candidates actually see.

The lines used to draw the head were good, mainly single and clear, much less sketchy than in previous years. However, a large number of candidates lost credit because they tried to show details from the photograph with shading. There should be no shading in biological drawing; details should be represented by outline only. Occasionally light dots may be used for finer detail. In particular, many candidates shaded the eyes and a small number of candidates shaded the entire head. These were unnecessary and unacceptable.

Biological drawings need to be large and clear. Most heads were drawn larger than the photograph and candidates made appropriate use of the space available. A small number of candidates drew the complete animal and consequently the head was too small.

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The eyes and antennae were mostly accurately represented. The antennae were seen drawn with single or double lines. For such a small feature, both were considered acceptable.

Close observation of the head of arthropod **B** would reveal that there were very clear mouthparts visible. There was a definite space between the two mouthparts at the base of the head. Although many candidates did notice these, quite a number of candidates did not make any attempt to show them. Credit was given for observing the mouthparts and trying to draw them on the head. The variety of sizes and details varied tremendously between candidates. Their representations varied from a single line down part of the head to the base, fang-like structures and massive serrated mandibles. Candidates need more practice with drawing specimens, in particular drawing parts in proportion and to scale.

The majority of candidates did label their drawings successfully although common errors were to label antennae as tentacles or antlers.

(b) (i) Most candidates correctly identified the arthropods as insects. A common error was arachnids.

(ii) The most obvious visible features, common to both **A** and **B**, are that they each have six legs and three body parts; the head, thorax and abdomen. The most common errors were to describe the body as having three body segments or to refer to feet or appendages for legs. Although arthropods have a segmented body it is not specific to insects and neither are jointed legs. A number of candidates gave wings as a feature, but this was not acceptable because arthropod **B** does not have any wings.

(c) (i) Candidates were not asked to state for which two different carbohydrates they would be testing. If the tests were named then they had to be restricted to the tests for reducing sugars and starch.

This question was answered well; the majority of candidates were familiar with the tests for starch and for reducing sugars. The suggested experimental methods and references to safety procedures were detailed.

The tests described should involve the use of reducing sugar and starch test reagents only, i.e. Benedict's solution and iodine solution. Some candidates incorrectly used the correct reagents but linked them to the wrong test, e.g. Benedict's solution for the starch test. Another common error was to use other reagents, e.g. biuret or ethanol, instead of, or in addition to, the expected reagents, often testing for a wider variety of foods.

The most common omission was the failure to prepare the banana by either simply cutting, mixing with water or, more effectively, by crushing or grinding.

Most candidates correctly used Benedict's solution, although a small number did not heat it. Many used a water bath, but a small number incorrectly used a warm water bath or water bath alone; these gained credit for safety but could not be credited for heating.

The most common error for the starch test was to use iodine instead of iodine solution or drops of iodine. Iodine is a solid but needs to be dissolved in potassium iodide solution for food testing.

The safety features were well known and many were given.

Weaker candidates confused biuret with Benedict's solution, or tested for fats, implying that fat was a carbohydrate.

(ii) In this part it was important to correctly link the observations expected either to the correct reagent or to the carbohydrate being tested. Overall, this was answered well. Those candidates who knew the test procedures for starch and reducing sugars were also familiar with the results expected. The most common error was to use the term 'sugars' instead of glucose or reducing sugars.

(d) This part was answered well. In **(c)** candidates were shown a piece of apparatus which could be used as a trap in which to catch fruit flies and this set-up could have been used as a basis for part **(d)**. Many candidates successfully described such an experiment which would work well. There were quite a few candidates who devised a suitable similar experiment.

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For the method, any idea of placing both the banana and plantain in separate or the same container with the fruit flies having free access to both foods was acceptable. No credit was given for two closed containers with a separate set of fruit flies in each because the flies would eat the food available and were not free to choose between the banana and plantain.

To collect the results, some candidates chose to count the flies visiting each food and others looked for a change in mass of the two fruits; both ideas were accepted. Credit was not given to candidates who simply looked to see which fruit had been eaten the most as this was not a scientific method. The change would be negligible and not necessarily visible to the naked eye in a reasonable period of time. Quantifiable ideas were required. Ensuring that the experiment is conducted in the same time period, i.e. the idea of a controlled variable, is important both for counting flies and looking for a change in mass, but quite a number of candidates used vague references to leaving 'for some time', 'for a few hours', 'after a while', etc.

Most candidates did not attempt to pull together their expected results to make a conclusion that would answer the question being investigated.

A small number of candidates suggested testing the banana and plantain for sugars and starch with Benedict's solution and iodine solution in an attempt to find out which would contain more carbohydrates and so be more likely to attract the fruit flies.

Question 3

(a) (i) Able candidates correctly identified the floral parts, but all possible combinations were seen, some involving all the relevant structures in an incorrect sequence and others involving any parts linked to flowers.

(ii)(iii) Many correctly identified these parts but all letters were seen. The correct names, anther for **B** and stigma for **D** were accepted. **B** and **D** were frequently reversed and given as the two possible alternatives but for the incorrect part.

(iv) This part of the question was not well answered. The photograph of the Amaryllis has very noticeable large petals with clear honey/nectar guides. These are very clear indications of insect pollination. The most common error, however, was to describe colourful petals, which are not visible in the black and white photograph. Other features which were not visible were included, e.g. a scent, a nectary, microscopic details of pollen grains and references to the texture such as a sticky stigma. Observations needed to be shown in the photograph as the word 'visible' was stressed in the question. Another common error was that the anthers and filaments are hanging outside the petals, this is a feature associated with wind pollinated flowers. Some candidates tried to recall features of insect pollinated flowers and described that the anthers were within the petals. This did not gain credit because in the photograph of the Amaryllis flower this is not obvious.

(b) This calculation was answered well. Most measurements were accurate, although the most common error was to give an answer in cm rather than mm. The majority of candidates correctly calculated the length. Magnification is the number of times an image is enlarged and the actual length would be found by dividing the measured length by 200. The most common error was to multiply by 200 rather than divide by it.

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BIOLOGY

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The standard of English was good and the presentation of answers showed a reasonable understanding of the questions. Overall, the paper produced a complete range of marks. Most candidates showed that they had adequate time to finish the paper.

In **1(c)(ii)** candidates were asked to describe an experiment to test a hypothesis about enzymes. Many candidates only gave an outline and did not describe any practical procedure or give any expected results to explain how the hypothesis could be tested.

In **2(a)** candidates' outline diagrams showed less shading than in past examinations, but the diagrams were very inaccurate in proportion and details. Many drawings did not resemble the specimen illustrated in Fig. 2.1. In particular, the drawings of the mouthparts were very variable. Much more practice is needed; candidates need to be trained how to make more careful observations in order to produce drawings which are a more accurate representation of the specimen.

In **2(c)(i)** the practical procedures involved in food testing were well known and described accurately.

In **3(b)** many candidates made accurate measurements and successfully calculated the actual length of the pollen grain.

Comments on specific questions

Question 1

The first part of this question was based on an experiment to investigate the effects of lemon juice on the activity of an enzyme found in apple cells. This enzyme is a catalyst for the reaction which oxidises the colourless compounds in apple tissue converting these chemicals to coloured compounds.

(a) Most candidates were aware that the change of colour of the litmus paper showed lemon juice to be acidic. A small number were confused between low and high pH, and a few stated that the lemon juice was alkaline. Weaker candidates incorrectly gave answers referring to the oxidation process, rusting or suggested that it was a positive result with Benedict's solution.

(b) Most candidates correctly described the differences between the appearances of the cut surfaces of the apple pieces in dish **1** and dish **2**.

(c) (i) Many candidates answered this clearly and succinctly, correctly linking the acid in lemon juice to the lack of browning, and hence inactivity of the enzyme. The idea that the enzyme had been denatured was quite well understood and a small number of able candidates gave descriptions of the damage to the active site of the enzyme. There were, however, some candidates who, incorrectly, said that the enzyme had been killed. Enzymes are not living organisms. Enzymes are biological molecules that catalyse reactions and therefore enzymes can be destroyed but not killed.

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Quite a large number of candidates failed to make the link with the acid in the lemon juice and so they were only able to gain credit for the colour change. Some of these candidates explained about the activity of the enzyme in water and the oxidation process, and then incorrectly tried to link the failure to change colour with the idea that the lemon juice prevented oxygen reaching the apple.

(ii) The question stated 'this colour change' and so it was expected that the candidates' experiments would use apple. Many candidates incorrectly described experiments using different food substances or enzymes, e.g. those in washing powder. Having made the link between pH and enzyme activity, it was expected that candidates would describe an experiment which looked at the effect of temperature on enzyme activity.

This question was not well answered. Only a small number of more able candidates gave a complete method with expected results and an explanation that linked their result to enzyme activity. These candidates gave specific temperatures at the extremes, or conditions which would prevent an enzyme from functioning, e.g. boiling or placing in a refrigerator They then described the results that would be expected, linking these results to enzyme activity, e.g. boiling denatures enzymes and so there would be no colour change.

Many answers were incomplete, candidates simply stating that the apple should be placed in a range of different temperatures, without giving any examples. A common error was to choose a range of temperatures that would all give a colour change. Temperatures over 50 °C or below 5 °C would be needed to prevent colouring and show the effect on enzymes.

Other candidates did correctly identify suitable temperatures or conditions but then stated that the results should be observed rather than describing any expected results. Finally, there were some who failed to give any explanation as to why their expected results would link to enzyme activity.

(d) (i) Answers describing the colour difference at the end of 20 minutes, or for any stated time period, were accepted. To explain the idea of a quicker reaction, descriptions of an immediate colour change for the cut surface were accepted. Able candidates gained full credit here. Overall, however, it was not answered well and the most common error was for candidates to simply repeat the colour changes as given in the results table without drawing out any differences. A small number of candidates incorrectly described differences in appearance as being either rough or smooth.

(ii) Many candidates realised that breaking apples may cause less damage to cells or that it could release less contents. Better candidates went further and explained that it was possible that the cells were separated rather than cut open. Weaker candidates only gave answers about the knife cutting cells without comparing it to breaking the piece of apple. A small number of candidates incorrectly tried to link the browning of the cut apple with the knife, stating that the knife was causing an oxidation or rusting reaction on the surface of the apple.

Question 2

(a) Overall, the way in which the head was drawn was acceptable but, considering that there was only one specimen to look at, there were many different interpretations of what the head looked like and the head structure was shown from a number of different angles. Candidates should represent the orientation, features and proportions accurately. The objective is to produce diagrams which are true representations of what the candidates actually see.

The lines used to draw the head were good, mainly single and clear, much less sketchy than in previous years. However, a large number of candidates lost credit because they tried to show details from the photograph with shading. There should be no shading in biological drawing; details should be represented by outline only. Occasionally light dots may be used for finer detail. In particular, many candidates shaded the eyes and a small number of candidates shaded the entire head. These were unnecessary and unacceptable.

Biological drawings need to be large and clear. Most heads were drawn larger than the photograph and candidates made appropriate use of the space available. A small number of candidates drew the complete animal and consequently the head was too small.

The eyes and antennae were mostly accurately represented. The antennae were seen drawn with single or double lines. For such a small feature, both were considered acceptable.

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Close observation of the head of arthropod **B** would reveal that there were very clear mouthparts visible. There was a definite space between the two mouthparts at the base of the head. Although many candidates did notice these, quite a number of candidates did not make any attempt to show them. Credit was given for observing the mouthparts and trying to draw them on the head. The variety of sizes and details varied tremendously between candidates. Their representations varied from a single line down part of the head to the base, fang-like structures and massive serrated mandibles. Candidates need more practice with drawing specimens, in particular drawing parts in proportion and to scale.

The majority of candidates did label their drawings successfully although common errors were to label antennae as tentacles or antlers.

(b) (i) Most candidates correctly identified the arthropods as insects. A common error was arachnids.

(ii) The most obvious visible features, common to both **A** and **B**, are that they each have six legs and three body parts; the head, thorax and abdomen. The most common errors were to describe the body as having three body segments or to refer to feet or appendages for legs. Although arthropods have a segmented body it is not specific to insects and neither are jointed legs. A number of candidates gave wings as a feature, but this was not acceptable because arthropod **B** does not have any wings.

(c) (i) Candidates were not asked to state for which two different carbohydrates they would be testing. If the tests were named then they had to be restricted to the tests for reducing sugars and starch.

This question was answered well; the majority of candidates were familiar with the tests for starch and for reducing sugars. The suggested experimental methods and references to safety procedures were detailed.

The tests described should involve the use of reducing sugar and starch test reagents only, i.e. Benedict's solution and iodine solution. Some candidates incorrectly used the correct reagents but linked them to the wrong test, e.g. Benedict's solution for the starch test. Another common error was to use other reagents, e.g. biuret or ethanol, instead of, or in addition to, the expected reagents, often testing for a wider variety of foods.

The most common omission was the failure to prepare the banana by either simply cutting, mixing with water or, more effectively, by crushing or grinding.

Most candidates correctly used Benedict's solution, although a small number did not heat it. Many used a water bath, but a small number incorrectly used a warm water bath or water bath alone; these gained credit for safety but could not be credited for heating.

The most common error for the starch test was to use iodine instead of iodine solution or drops of iodine. Iodine is a solid but needs to be dissolved in potassium iodide solution for food testing.

The safety features were well known and many were given.

Weaker candidates confused biuret with Benedict's solution, or tested for fats, implying that fat was a carbohydrate.

(ii) In this part it was important to correctly link the observations expected either to the correct reagent or to the carbohydrate being tested. Overall, this was answered well. Those candidates who knew the test procedures for starch and reducing sugars were also familiar with the results expected. The most common error was to use the term 'sugars' instead of glucose or reducing sugars.

(d) This part was answered well. In **(c)** candidates were shown a piece of apparatus which could be used as a trap in which to catch fruit flies and this set-up could have been used as a basis for part **(d)**. Many candidates successfully described such an experiment which would work well. There were quite a few candidates who devised a suitable similar experiment.

For the method, any idea of placing both the banana and plantain in separate or the same container with the fruit flies having free access to both foods was acceptable. No credit was given

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for two closed containers with a separate set of fruit flies in each because the flies would eat the food available and were not free to choose between the banana and plantain.

To collect the results, some candidates chose to count the flies visiting each food and others looked for a change in mass of the two fruits; both ideas were accepted. Credit was not given to candidates who simply looked to see which fruit had been eaten the most as this was not a scientific method. The change would be negligible and not necessarily visible to the naked eye in a reasonable period of time. Quantifiable ideas were required. Ensuring that the experiment is conducted in the same time period, i.e. the idea of a controlled variable, is important both for counting flies and looking for a change in mass, but quite a number of candidates used vague references to leaving 'for some time', 'for a few hours', 'after a while', etc.

Most candidates did not attempt to pull together their expected results to make a conclusion that would answer the question being investigated.

A small number of candidates suggested testing the banana and plantain for sugars and starch with Benedict's solution and iodine solution in an attempt to find out which would contain more carbohydrates and so be more likely to attract the fruit flies.

Question 3

(a) (i) Able candidates correctly identified the floral parts, but all possible combinations were seen, some involving all the relevant structures in an incorrect sequence and others involving any parts linked to flowers.

(ii)(iii) Many correctly identified these parts but all letters were seen. The correct names, anther for **B** and stigma for **D** were accepted. **B** and **D** were frequently reversed and given as the two possible alternatives but for the incorrect part.

(iv) This part of the question was not well answered. The photograph of the Amaryllis has very noticeable large petals with clear honey/nectar guides. These are very clear indications of insect pollination. The most common error, however, was to describe colourful petals, which are not visible in the black and white photograph. Other features which were not visible were included, e.g. a scent, a nectary, microscopic details of pollen grains and references to the texture such as a sticky stigma. Observations needed to be shown in the photograph as the word 'visible' was stressed in the question. Another common error was that the anthers and filaments are hanging outside the petals, this is a feature associated with wind pollinated flowers. Some candidates tried to recall features of insect pollinated flowers and described that the anthers were within the petals. This did not gain credit because in the photograph of the Amaryllis flower this is not obvious.

(b) This calculation was answered well. Most measurements were accurate, although the most common error was to give an answer in cm rather than mm. The majority of candidates correctly calculated the length. Magnification is the number of times an image is enlarged and the actual length would be found by dividing the measured length by 200. The most common error was to multiply by 200 rather than divide by it.

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