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BIOLOGY

Paper 0610/11
Multiple Choice

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

General comments

Three questions (**10** and **21** and **26**) proved to be very difficult, and two (**32** and **33**) proved rather easy.

Comments on individual questions

Question 2

A was a popular incorrect answer and it even attracted a very few of the otherwise more able candidates. The problem may have been that many would rely on recognising the organism (in this case, *Anopheles*) without checking the others for the characteristic number of legs that insects possess, which would then have indicated that 2 of the organisms shown belonged to this group.

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Question 4

Although it should be possible to arrive at the correct answer with almost no knowledge of the group to which the organism belongs, it would appear that a few of the more able candidates were sufficiently unfamiliar with the characteristic features of a mollusc to believe that a snail has more than one muscular foot, or, perhaps they did not think carefully enough before answering.

Question 10

This question proved to be one of the most difficult on the paper. Again it is likely that insufficient thought was applied before selecting an answer. To see a potato strip in a 'concentrated solution of salts' appears immediately to have suggested 'osmosis' as an answer. However, the question twice uses the word 'boiled', and begins by stating that boiling destroys the cell membrane. This should have eliminated osmosis as a factor, leaving diffusion as the process involved.

Question 21

This question proved difficult, but largely as a result of confusion over what the graph was showing. Without the graph, most candidates would probably state that raising the ribs increases the volume in the chest cavity lowering the pressure in the lungs. When faced with interpreting the graph, many allowed themselves to suggest that raising the ribs *increases* the pressure in the lungs. Significantly, the more able candidates avoided this confusion.

Question 26

The fruit shown was unfamiliar to candidates. The stamens and flower stalk should be immediately recognisable and thus it should be known that the remains of the style would be at the furthest end of the fruit. Clearly this was not the case for all but the best candidates, since 50 % appeared to mistake a stamen for the style.

Question 28

Dry mass is traditionally a topic with which candidates experience problems, but this question also indicated that many do not see a tropism as a *growth* process, and therefore as one that would involve a dry mass increase.

Questions 32 and 33

Food chains and food webs are ecological topics with which candidates are traditionally comfortable, and these two questions served to illustrate that fact.

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BIOLOGY

Paper 0610/12
Multiple Choice

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

General comments

Three questions (**11**, **17** and **32**) proved to be very difficult, and two (**1** and **2**) proved rather easy.

Comments on individual questions

Questions 1 and 2

Food chains and food webs are ecological topics with which candidates are traditionally comfortable, and these two questions served to illustrate that fact.

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Question 11

The fruit shown was unfamiliar to candidates. The stamens and flower stalk should be immediately recognisable and thus it should be known that the remains of the style would be at the furthest end of the fruit. Clearly this was not the case for all but the most able candidates, since almost 50 % mistook a stamen for the style (or they really did believe that pollen tubes grow down the stamen).

Question 17

This question proved difficult, but largely as a result of confusion over what the graph was showing. Without the graph, most candidates would probably state that raising the ribs increases the volume in the chest cavity lowering the pressure in the lungs. When faced with interpreting the graph, many allowed themselves to suggest that raising the ribs *increases* the pressure in the lungs. Significantly, the more able candidates avoided this confusion. Careful thought before answering is essential.

Question 19

A was a popular incorrect answer and it even attracted a very few of the otherwise very able candidates. The problem may have been that many would rely on recognising the organism (in this case, *Anopheles*) without checking the others for the characteristic number of legs that insects possess, which would then have indicated that 2 of the organisms shown belonged to this group.

Question 24

It is important that candidates learn that tropisms are a *growth* process, not simply a bending. As growth will increase dry mass, option **C** is thus invalid. A quarter of the candidates did not realise this.

Question 32

This question proved to be one of the most difficult on the paper. Again it is likely that insufficient thought was applied before selecting an answer. To see a potato strip in a 'concentrated solution of salts' appears immediately to have suggested 'osmosis' as an answer. However, the question twice uses the word 'boiled', and begins by stating that boiling destroys the cell membrane. This should have eliminated osmosis as a factor, leaving diffusion as the process involved.

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BIOLOGY

Paper 0610/13
Multiple Choice

There were insufficient entries for this component for us to be able to produce a report.

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BIOLOGY

Paper 0610/21
Core Theory

Key messages

- Candidates should complete all parts of all questions even if they are not sure of the answer as this way at least they have a chance of getting the marks.
- Some areas of the syllabus need particular attention including the nervous system and heart and circulation.
- Candidates should ensure that they read the questions carefully and thoroughly so that they answer the question that has actually been asked. Candidates should ensure that they carefully follow the instructions in questions requiring them to place an answer on a diagram.
- Candidates should respond differently to questions featuring 'describe' and 'explain' in the question stem, as explained in the glossary in the syllabus, and should use the mark allocation as a guide to how much detail to give.

General comments

As in previous years candidates appeared to have enough time to complete the paper, although there were significant numbers of candidates who did not complete all parts of all questions. The paper was designed to suit the candidature but most candidates found at least some of the paper demanding. Questions on the nervous system and heart and circulation proved particularly challenging. Many candidates showed that they had read the questions carefully and thoroughly, but others wrote answers which were not relevant to the question asked, especially in **Question 3(a)(i)**, **Question 6(a)(vi)**, **Question 6(b)**, and **Question 7(a)**. In **Question 4(a)** and **Question 7(a)**, many candidates correctly placed their responses on the diagram, but there were others who ignored these instructions.

Comments on specific questions

Question 1

The use of the key seemed to present little difficulty to the majority of candidates and many gained full credit. In such questions candidates should give the full scientific name, as printed in the key, and not just the species name such as *rufus* or *leo*. Some answers in the table either repeated *L.caracal* as the name of one of the five cats that the candidates had to identify or identified two different cats with the same name. A small number of candidates ignored the instructions in the question and incorrectly gave common names for the cats illustrated in Fig. 1.1, including some who gave common names of completely unrelated animals.

Question 2

Some candidates seemed to have an understanding of the meaning of the term 'balanced diet' but responses to **(a)(i)** were often very vague. Candidates who listed the necessary nutrients often overlooked the need for fibre or water. Candidates should be aware that a balanced diet varies according to a number of factors such as the sex, age, activity of the person and in some cases the possibility of pregnancy. Many candidates in **(a)(ii)** correctly omitted responses already listed in the stem of the question.

Some candidates gave responses in **(b)(i)** indicating awareness of the role of fibre in peristalsis and the risk of constipation when too little is included in the diet and some responses did link a deficiency of fibre to colon cancer. Other candidates incorrectly linked a lack of fibre with the lack of iron and consequently with anaemia. Many candidates had a good understanding of the effects of too much animal fat and quoted its link to obesity and also to various coronary and vascular problems in **(b)(ii)**.

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In **(c)** most candidates understood the role of calcium in the hardening and strengthening of bones and teeth. Some candidates correctly gave the commonest deficiency problem which is rickets in developing bones and the bones bending (rather than breaking). Some candidates also realised that a lack of calcium can also affect blood clotting and muscle contraction as calcium is a factor in both of these processes and also an increased risk of tooth decay. Some candidates were confused between the roles of calcium and iron.

Question 3

Most candidates realised from the question stem that Fig. 3.1 showed a male reproductive system although a few named parts of the female system. Some candidates correctly gave the urethra, **M**, and the ureter, **O**, but others reversed them or gave ambiguous spellings which could not be credited. A few candidates were aware of the role of the prostate gland and the role of the testes in producing testosterone.

Some candidates correctly identified the testes as the site of sperm production, but others thought that all three structures listed in **(a)(ii)** produced or stored sperm.

In **(b)(i)** some responses correctly indicated the location for a vasectomy although others gave incorrect locations. Most candidates identified the condom as the correct method in **(ii)**. A few candidates correctly explained that the condom is impermeable, prevents body fluids from coming in contact with tissues of the other person but others repeated the information given in the question. Virtually all candidates correctly identified a sexually transmitted disease in **(iii)**.

Question 4

A few candidates correctly labelled all the details of Fig. 4.1 but others muddled the sensory neurone, **A**, with the motor neurone, **B**. A very few candidates named the two types of tissue that act as effectors in **(a)(ii)**.

Some candidates correctly identified the features of reflex actions as rapid and automatic responses but others gave details rather than features. In **(b)(ii)** many were able to state an example of a reflex action, the withdrawal, iris and knee jerk reflexes being the most common responses.

Question 5

Some candidates correctly identified organs where meiosis occurs and correctly gave differences. Such candidates correctly gave differences in terms of processes affecting nuclei of cells rather than whole organisms. Others gave gametes (individual cells) or general parts of the reproductive system (e.g. petal, penis) as locations for meiosis. Some candidates gave responses in the wrong columns in **(a)(iii)**.

A number of candidates realised that mutations, **(b)(i)**, involved either changes to genes or DNA or changes to the structure or number of chromosomes. In **(b)(ii)** some candidates appreciated that the environmental factors involved are X-rays, ultraviolet light, mutagenic chemicals such as cigarette tar and ionising radiation such as alpha, beta or gamma rays rather than vague responses such as pollution or radiation (there are forms of radiation, such visible light and infra-red that are not mutagenic).

Question 6

A few candidates identified photosynthesis as the response to **(a)(i)**. Some of these linked this process to the chemical chlorophyll although there were a number of responses that named chloroplast structures, instead in **(a)(ii)**. In **(a)(iii)** some candidates correctly did not include the 1000 kJ in the secondary consumers and therefore made correct subtraction from the original 100 000 kJ. A few candidates were able to identify groups of decomposers such as bacteria but some named categories such as consumers and producers or specific examples of these.

Some candidates reached the correct response in **(v)** while others made factor of 10 errors in the calculation or used an incorrect method. In **(a)(vi)** candidates often offered logical responses and sometimes developed them fully. Losses such as heat energy from the primary consumer, or loss in excreta or the use of energy in body activities and metabolism were correctly given.

A very limited number of candidates could explain the term ‘population’ in **(b)**. Some candidates confused this term with the term ‘community’. Some tried to explain the term in economic or geographical terms rather than in the biological context of this syllabus.

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Question 7

Many candidates placed correct letters next to the correct arrows on the carbon cycle on Fig. 7.1, although some did not follow the instructions and incorrectly placed letters in boxes. Others placed a letter correctly but then lost the mark by placing the same letter incorrectly elsewhere on the diagram. There were two or more correct response positions for both **D** and **R**. Some candidates muddled decomposition with combustion.

Overall candidates seemed familiar with some of the reasons for the rise in the concentration of atmospheric carbon dioxide over the last century and a half.

Question 8

Many candidates correctly labelled blood vessels in **(a)(i)**, but some candidates incorrectly named chambers of the heart. In **(a)(ii)** and **(iii)** some candidates correctly identified the tricuspid valve and the semilunar valves although others got them confused. A few candidates were able to identify the relevant side of the heart responsible for pumping blood into the aorta and to identify muscle contraction of the left ventricle wall as responsible for this. Some candidates incorrectly suggested that the blood was forced along by the valves or forced back into the atria. Contraction of the muscular walls of the left ventricle results in a rise of pressure that forces the bicuspid valve shut at the same time as forcing the semilunar valve open and forces the blood into the aorta. A few candidates identified the coronary vessel or the hepatic artery and hepatic portal vein in **(c)(i)** and **(ii)**.

Question 9

Some candidates linked the term transpiration in **(a)** to plants and a few appreciated the difference between the loss of water as vapour from the aerial parts of plants, especially the leaves, and the flow of water through the plant that results from the effect of transpiration. Many candidates referred to the loss of water vapour via the stomata and a few candidates to the role of diffusion. Others incorrectly referred to sweating. In **(b)** many candidates identified the effects of changes in temperature, light intensity, humidity and air movement on the rate of transpiration and some were able to describe how or why the factors had their effects.

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BIOLOGY

Paper 0610/22
Core Theory

Key messages

- Candidates should complete all parts of all questions even if they are not sure of the answer as this way at least they have a chance of getting the marks.
- Some areas of the syllabus need particular attention including genetics and leaf structure.
- Candidates should ensure that they read the questions carefully and thoroughly so that they answer the question that has actually been asked. Candidates should ensure that they carefully follow the instructions in questions requiring them to place an answer on a diagram.
- Candidates should respond differently to questions featuring 'describe' and 'explain' in the question stem, as explained in the glossary in the syllabus, and should use the mark allocation as a guide to how much detail to give.

General comments

As in previous years candidates appeared to have enough time to complete the paper, although there were significant numbers of candidates who did not complete all parts of all questions. The paper was designed to suit the candidature but most candidates found at least some of the paper demanding. Questions on genetics and leaf structure proved particularly challenging. Some candidates were able to apply basic principles in less familiar situations for example in **Question 6** where they transferred their knowledge of digestion and nourishment of the offspring from one mammal (humans) to another (sheep).

Comments on specific questions

Question 1

In **(a)(i)** most candidates were able to name a solution that could show the presence of carbon dioxide. They did not need to describe the result of the test. However, some just wrote 'water' as a response while others suggested iodine or Benedict's solution. In **(a)(ii)** many suggested respiration as one characteristic, but few named excretion as the second.

In **(b)** most candidates listed at least two other characteristics of living things although a number did not note that they were asked for three other characteristics. Some candidates lost marks through vague terms such as feeding and get bigger or giving features not characteristic of all living things such as locomotion, photosynthesis or thinking.

Question 2

Many candidates read the question carefully and identified that part **(a)** was about energy requirements and **(b)** about proteins, however, some candidates muddled up the two. Some candidates correctly suggested reasons for the differences between males and females in **(a)(i)**, citing differences in size or metabolism but others incorrectly calculated the difference or gave vague answers in terms of amount of work.

In **(ii)**, many candidates commented that the breastfeeding female had to provide energy for both herself and her baby although others incorrectly calculated the difference or thought that 'breastfeeding female' applied to the child.

In **(b)(i)** many candidates compared the protein requirements of the three mature females and realised that both female parents provided protein for the developing embryo or for the child. A few commented on the protein needs of the average female and suggested that proteins were needed for growth and repair of body cells. In **(ii)** some candidates compared the protein requirements of the two teenagers but fewer linked the ages to puberty and mentioned the more rapid growth or greater overall size of males. Many candidates commented on the physical activity of the teenagers and some linked this to wear and tear on tissues.

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In **(c)** a significant number of candidates linked the higher iron requirement of females to blood loss during menstruation.

Question 3

Some candidates had knowledge of the structure of the skin in **(a)(i)** although others omitted this question. In **(a)(ii)** many candidates suggested pain and some touch. Some candidates gained the temperature change mark by giving heat or cold, but others lost this mark by putting temperature (skin cannot detect specific temperatures), burning or freezing.

In **(b)** most candidates related sweating to the need to reduce body temperature and some explained how this was brought about. A few candidates realised that sweating goes on all the time and increases as body temperature rises above normal, however, others thought that the liquid sweat cools the body. Many candidates mentioned evaporation without specifically describing the cooling effect of the evaporation of the water in sweat.

Question 4

In **(a)(i)** some candidates scored well when naming structures on the diagram. **F**, the vagina, was probably the commonest correct answer and a few were able to name the urethra (**E**) and the anus (**G**). The stem of the question informed observant candidates that this was the female reproductive system. In **(ii)** some candidates correctly described the roles of the ovaries and the oviducts but some candidates incorrectly suggested that the ovaries moved along the oviducts and were fertilised. Most candidates knew that the oviducts linked the ovaries to the uterus and that sperm travelled along the oviducts. Some candidates knew that the ovaries produce female gametes or ova but others referred vaguely to sex cells. A small proportion of candidates knew that ovaries produce the female hormones oestrogen and progesterone.

In **(b)(i)** many candidates suggested removal of the ovaries or uterus and others suggested cutting or tying of the oviducts. The term vasectomy was often used here and was not accepted unless it was explained as severing the oviducts. A few candidates seemed familiar with the femidom in **(ii)** and suggested a role for it other than birth control. In **(iii)** some candidates suggested the contraceptive pill and explained that it prevented ovulation or caused the formation of thick mucus that made the movement of sperm difficult or explain that spermicides kill the sperm. A few candidates incorrectly gave a barrier method of birth control. Some candidates gave vague responses such as use of medicines or drugs which needed further details.

Question 5

Many candidates found this question challenging. Some candidates clearly understood what was being asked and stated one example of continuous variation and one of discontinuous variation found in humans, however, other responses were muddled. A few candidates were able to state the factors, environmental, genetic, or both, which influence each type of variation. Some left this section blank.

In **(b)** some candidates had learned the definitions of gene and allele that are in the syllabus and therefore clear definitions of genes or alleles were given. Some candidates incorrectly thought that genes were made of chromosomes rather than a length of DNA.

In **(c)** candidates gave some valid comparisons of diploid and haploid nuclei. A few candidates made more than one valid point, reflecting the mark distribution.

Question 6

In this question candidates were expected to apply their knowledge to an unfamiliar situation, which some candidates successfully did. In **(a)** some candidates knew that plants took in mineral ions by diffusion, but more than half of those responding suggested that the process was osmosis which they should associate *only* with the movement of water. Some candidates knew that mineral ions are distributed in the xylem vessels.

A few candidates followed the hint in the stem of the question that calcium ions are absorbed with digested food and used by the sheep in the same way that they would be used in a human. These candidates correctly suggested that absorption occurs mainly through the villi of the ileum. Many candidates suggested incorrectly that the ions were absorbed by either the stomach or the liver. In **(ii)** vitamin D was known by many candidates although others incorrectly gave vitamin C. In **(iii)** many candidates linked calcium ions to

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bone or tooth development. In **(iv)** many candidates did not appreciate that as a mammal the sheep could pass the ions to its lamb either across the placenta before birth or in milk during suckling.

In **(c)** a few candidates appreciated that much of the energy stored in the body of the sheep would be released during respiration and used for the metabolic activities of the parent and only a proportion passed onto the lamb. Other candidates thought through the question in part and described energy losses along food chains and between trophic levels.

Question 7

This was a straightforward question about leaf structure and function in which some candidates revealed their knowledge of the topic. In **(a)** many candidates mentioned that the cuticle was transparent and some linked this to letting light through to the palisade. Some candidates were confused between the cuticle and the epidermis and a few incorrectly stated that the cuticle carried out photosynthesis or trapped light. The impermeable nature of the cuticle was sometimes mentioned and some of these candidates correctly stated that this was to keep water inside the leaf cells. A few candidates mentioned the role of the cuticle in keeping out pathogens. In **(ii)** many candidates mentioned stomata and some candidates linked this to the diffusion of carbon dioxide. Some candidates also mentioned the concentration gradient and a few mentioned the air spaces.

Most candidates named at least one suitable factor in **(b)**.

Question 8

Most candidates performed well in at least some parts of this question. They are obviously familiar with food webs. Part **(a)** was known by some candidates who had learned the definition in the syllabus, however, other candidates confused the term 'ecosystem' with a food web or limited it to just the biotic factors in the environment. In **(ii)** most candidates knew the difference between producers and consumers, and some expressed this in clear scientific terms. Some responses were vague and others dealt with it in economic terms or the relative positions of consumers and producers in a food chain. Candidates should be able to give precise definitions of these terms as in the syllabus.

In **(b)** the majority of candidates scored maximum credit. A few candidates incorrectly drew pyramids or included more than five organisms in their chain and a small number drew branching diagrams.

In **(c)** it was pleasing that many candidates were able to suggest and explain the likely effects on the snake population of the loss of part of their food supply. There were many logical ideas.

In **(d)** many candidates gave acceptable responses by including effects on the ecosystem such as loss of pollinating insects or accumulation of poisons in the food chain.

Question 9

Most candidates knew that enzymes are biological catalysts, speeding up the rate of chemical reactions, and thus gained credit in **(a)**. Fewer candidates commented on the protein nature of enzymes. A few candidates understood the problem in **(b)**, appreciating that as lactase is a protein, the enzyme would be denatured or coagulated in the acidic pH of the stomach and thus made ineffective. Some candidates also realised that the lactase could be digested in the stomach. Others confused lactase with the sugar lactose or introduced amylase into their response.

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BIOLOGY

Paper 0610/31
Extended Theory

Key messages

- Candidates should be aware of the difference between 'describe' and 'explain' in the question stem and that the mark allocations serve as a guide to the degree of detail expected. Extended papers require precision in answers and an attention to detail. See **Question 4 (d)**.
- Care needs to be taken over the use of correct terminology. The following are examples of incorrect terms used in this paper: epidermis and endothelium for epithelium in **Question 1**, marine for freshwater in **Question 2**, antibiotics for antibodies in **Question 3**, genotype for phenotype in **Question 4**, prey for predator in **Question 6**.
- When describing movement of molecules across membranes, candidates should always be clear about concentrations and state the substance that they are describing. Answers that deal with osmosis should be given in terms of water potential gradients (see ***Section II***, 4.3 in the syllabus).

General comments

The performance of candidates on the questions correlated well with the overall performance on the paper with the exception of **Question 6**. It appeared that success on this question on natural selection **(c)** was not dependent on overall success on the whole paper, but to an ability to identify this as the 'selection question'. Most candidates attempted all of the questions and few seemed to have problems completing the paper.

Questions 1 and **2** proved to be challenging and candidates struggled with interpreting and analysing the information provided. Candidates who interpreted the information in Fig. 1.2 correctly often gained credit for all the marking points in **(c)** and **(d)**. **Questions 3(a)** and **(d)**, **5(a)** and **Question 6** proved to be high scoring questions for many candidates. As a result the paper differentiated well between the candidates.

After some improvement in recent years, the answers to **Question 2(b)** on the nitrogen cycle often lacked the detailed knowledge required. Candidates tended not to describe nitrogen fixation correctly and therefore found it difficult to explain its importance.

It was rare to find candidates applying knowledge to unfamiliar questions. A good example of this is the role of proteins in cells in **Question 2(c)**. Many candidates gave the role of proteins in the diet or listed the types of proteins found in the human body without realising that some function outside cells in body fluids rather than inside cells. Similarly, the function of DNA inside cells was given in terms of inheritance.

Question 2(d) prompted some very good answers on the effects of fertilisers on freshwater ecosystems, although many candidates stated that the plants and animals involved are marine. This misuse of the term *marine* has been noted before.

Question 5(a) prompted an impressive number of correct balanced equations often incorporating extra detail about light energy and chlorophyll.

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Comments on specific questions

Question 1

This question provided candidates with photographs of the lining of the small intestine and a table showing the balance sheet for water secreted into and absorbed from the alimentary canal.

(a) The three correct labels for the structures shown in the photomicrographs were capillary, epithelium and lacteal. The presence of red blood cells in the capillary was the clue for the first box. 'Blood vessel' was not precise enough an answer. The Examiners decided to ignore any qualifications of the term *epithelium* even if 'ciliated' was used. The term endothelium was used incorrectly here. Some identified the goblet cells that are just visible in Fig. 1.1 and gained credit. Lymph(atic) vessel and lymph(atic) capillary were acceptable alternatives for lacteal although not seen very often; lymph was not accepted since the question asked for structures to be identified. 'Vacuole' and 'lymph node' were incorrect answers seen quite often. Many candidates gained credit for capillary and lacteal often leaving the middle box empty. Some candidates did not attempt this question at all.

(b) Candidates appeared unsure how to answer this question on the muscle tissue in villi. The Examiners expected candidates to realise that muscle contracts and therefore could move the villus. Successful answers referred to emptying of the lacteal and causing movement of blood in the capillaries. Some explained that the villi could be retracted and extended so changing the surface area and/or improving absorption. Movement of the villi is not involved in moving food along the intestine and is not involved in peristalsis – so these answers did not gain any credit. Often candidates stated that muscles contracted and relaxed, but did not refer to movement so did not gain credit. Quite a few candidates thought that mitochondria in the muscle tissue provided the energy for active uptake of glucose and other nutrients by epithelium. Some misread the question and stated that 'cilia waft mucus out of the respiratory tract'.

The rest of the question described an experiment involving the uptake of glucose and water by a bag made of intestine compared with a bag made from Visking tubing that acted as a control.

(c) The question stated that the concentration of glucose decreased in the bag made from intestine. Since the concentrations inside and outside the bag were both described as 'dilute', glucose must have been absorbed against a concentration gradient by active transport. The Examiners allowed 'absorption' as an alternative, but they did not allow 'diffusion' because of the presence of the glucose concentration round the bag. Some candidates stated that the intestinal cells would use glucose as a source of energy in their respiration and this answer was also credited. Many gave descriptions of diffusion or osmosis without reading the question properly about solutions being the same concentration. There were many examples of incorrect use of terminology, such as glucose moving by osmosis and water by active transport. Very few candidates gave confident answers to this question, but if active transport was given as the method then it was often correctly qualified.

(d) The candidates were told that after two hours there was less water in the bag made from intestine than in the bag made from Visking tubing. Some gained full credit for explaining what happened in the first bag without referring to Visking tubing at all. This was because it can be assumed that whatever happens in the intestine bag does not happen in the other bag. If glucose is removed from the bag, the water potential of the contents *increases* so that there is a water potential gradient and water moves by osmosis out of the bag. Those that did this often did not indicate the direction of the gradient. With no movement of glucose out of the Visking tubing bag, no movement of water by osmosis occurs. Candidates started their answers by talking about glucose concentration and *its* movement rather than moving on to talk about water potential and the movement of water. Many candidates thought that the difference was due to the bag made from intestine being permeable and that from Visking tubing being semi-permeable.

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(e) Table 1.1 showed the results of investigating the flow of water into and out of the human alimentary canal. Parts **(i)** and **(ii)** expected candidates to refer to the table and choose the part of the alimentary canal that secretes the most water and the part that absorbs the most water. Stomach and small intestine were the correct answers, but many candidates struggled to identify either. Some candidates gave 'large intestine' as the answer to **(ii)** despite the syllabus clearly identifying the small intestine as the site of most water reabsorption in the gut.

(iii) Many candidates had problems understanding this question. Water is added to food for a variety of reasons. The Examiners looked for precise answers that identified the following roles:

- softening food,
- lubrication of food,
- dissolving enzymes,
- dissolving food substances – both undigested and digested products,
- involvement in chemical digestion by taking part in the chemical reactions that breakdown large molecules of food.

Often answers related the function of water to activating enzymes and forming the food into a bolus. Also many stated that water 'adjusts the pH'.

(iv) Failure to absorb water from the alimentary canal leads to the loss of large volumes of water as so much is added to food as shown in Table 1.1. This leads to diarrhoea, rapid dehydration and the loss of valuable salts that are absorbed in the large intestine. Some candidates answered this question in this way, but others stated the roles that water performs in the rest of the body. The Examiners awarded minimal credit for this approach. Some candidates repeated the answers that they had already given in **(iii)** which did not attract any credit. Quite often candidates stated that water was absorbed into the digestive system to help digest food.

Question 2

This question began with the nitrogen cycle from ***Section IV*** of the syllabus, dealt with the roles of proteins and DNA *inside* cells from ***Sections III*** and ***IV*** and ended with eutrophication from ***Section IV***.

(a) The two processes identified by **A** and **B** in Fig. 2.1 were excretion or egestion and nitrification. Common errors were to confuse nitrification with other processes from the nitrogen cycle, such as nitrogen fixation and denitrification. The processes of egestion and excretion were commonly confused with the products of these processes, faeces and urine. There was no credit for 'death' as that was given in Fig. 2.1.

(b) Good answers to this question stated that root nodules of legumes contain nitrogen-fixing bacteria that convert nitrogen in the air within the soil into ammonia or ammonium ions. Amino acids are made from this fixed nitrogen and passed to legume plants where they are used to make protein. This makes nitrogen in the form of protein available to animals, such as the zebra in Fig. 2.1 when they eat legumes. Many candidates were unsure which process in the nitrogen cycle occurs in root nodules and answers included uptake of nitrate ions from the soil, nitrification and denitrification. Many also described the events that occur to recycle protein in dead legumes which did not answer the question. A common error was to say that the bacteria were in the soil and that the nitrate (or ammonia) was in the soil as well, to be taken up by the roots or root hairs. Quite a few discussed 'death and decay' too early in answer to gain much credit. Some gave ammonium ions and then changed them to nitrate ions rather than to amino acids.

(c) This question gave candidates scope to write about the roles of protein and DNA in cells. The proteins that candidates should know from the syllabus include proteins in membranes, haemoglobin and enzymes involved in respiration and photosynthesis. Many candidates simply repeated the roles of proteins in human nutrition such as 'growth and repair' or listed proteins that work outside cells, such as fibrinogen, antibodies and hormones. The syllabus contains little on the roles of DNA other than the component of genes that code for proteins. Many found it hard to express this idea. Some candidates stated that DNA is the information inside cells which was not credited unless qualified by *genetic*. Many referred to DNA's role in inheritance or stated that 'it gives us our characteristics' which did not answer the question. 'Controlling the activities of a cell'

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was given credit. DNA 'contains genes and/or chromosomes' was a common answer and this also was not given any credit.

(d) There were many answers to this question that described the sequence of events in freshwater ecosystems following pollution by fertilisers. Many stated that eutrophication occurs and then described what happens with sufficient detail to gain full credit. The points that were given most often were algal bloom, reduction in light reaching fixed plants, the death of plants and their decomposition by bacteria that reduce the oxygen concentration of the water. Answers usually finished with the death or migration of animals, such as fish. Some went straight to pollution of water with nitrates and the problems with drinking this. Common misconceptions were that algal blooms prevent oxygen from entering water and that the death of fixed plants causes the oxygen concentration to fall due to lack of photosynthesis. Common errors were 'algae uses up oxygen', 'fertiliser forms a surface which blocks sunlight', 'all aquatic organisms died as a result of reduced oxygen concentration of the water' and 'all the marine organisms died'.

Question 3

The question concerned events in human reproduction from late pregnancy onwards.

(a) The functions of the amniotic sac and amniotic fluid were known very well by many candidates. Most stated that the sac secretes or contains the fluid and then listed functions of the fluid or sac. Common errors included functions of the placenta which should have been given in **(b)**. For example, candidates stated that functions of the amniotic fluid are gas exchange, provision of nutrients and antibodies. Most candidates referred to protection afforded from mechanical damage. No credit was awarded for protection unqualified.

(b) The most common acceptable answers included provision of oxygen, nutrients and antibodies and the removal of carbon dioxide and urea. A minority of candidates also mentioned the secretion of progesterone and/or oestrogen. Weak answers referred to the provision of food rather than nutrients and to respiration and excretion in general terms.

(c) Most candidates stated correctly what happens to structures **A** and **B** from Fig. 3.1 during birth. They stated that **A** (cervix) dilated or becomes wider and **B** (the muscular wall of the uterus) contracts. Marks were lost by stating that **A** 'opens' during birth or that it 'relaxes'. Many candidates believed that structure **B** was lost as the afterbirth. Many thought that **B** was the amnion and therefore burst during birth.

(d) Candidates often included quite a few advantages and one or two disadvantages of breast-feeding. The Examiners did not credit more than three advantages so that they looked for at least one disadvantage. These were given in many cases and this was a high scoring question for many. Candidates did not gain credit for stating that diseases are transmitted in breast milk. The Examiners gave credit for naming viruses or a suitable example, such as HIV or hepatitis. No credit was awarded for AIDS.

Question 4

This question covered the topics of renal dialysis, kidney transplants, inheritance and codominance.

(a) Candidates were often unsure how to answer this question about the changes that occur to blood as it travels through a dialysis machine from **A** to **B**. Many referred to the bubble trap although that is found after **B**. Successful answers referred to the loss of urea or the decrease in its concentration and the loss or gain of glucose. Credit was also awarded for statements about salts and water. Many just mentioned waste products and did not specify names. Weaker answers referred to blood containing wastes that were cleaned from the blood by dialysis. Sometimes glucose was described as leaving the blood and was then reabsorbed showing some confusion between dialysis and the functions of the kidney tubule.

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(b) There were some excellent responses from candidates who explained the advantages of kidney transplants. Some candidates gave answers that dealt with the *disadvantages* of kidney transplants which were not asked. However, disadvantages of renal dialysis certainly were relevant and many candidates could give details of these. Many answers included the information that transplants are 'cheaper' without making it clear who benefits from this. Simply stating that transplants were cheaper or dialysis was more expensive would only gain credit if qualified. Candidates gained credit if they stated that the individual benefits by not having to pay to attend a hospital or the health service benefits by making dialysis machines available to more patients or not having the costs involved in maintaining a patient on dialysis. Two common misconceptions were that people needed to be permanently attached to a dialysis machine or that a dialysis machine had to be carried around all the time. The Examiners allowed candidates to gain credit for stating that the transplant kidney was permanent even though the life-span of transplanted kidneys is of the order of 10 to 12 years.

(c)

(i) This question required a genetic diagram to show how the girl described in the question inherited blood group O and a written explanation. In completing the genetic diagram the common errors were:

- giving the parental genotypes as a single allele, e.g. I^A,
- giving two alleles for each of the gametes, e.g. I^AI^O,
- writing the girl's genotype and phenotype in the wrong order,
- repeating a Punnett square in the answer lines.

The Examiners awarded credit for the parental genotypes, the gametes that had to be derived correctly, the girl's genotype and phenotype identified correctly. Further credit was available for a written explanation. The most common answer was that both parents were heterozygous containing the recessive allele, I^O. Quite a few obviously understood the genetics and gained partial credit, but did not cover the final marking point as they just drew a Punnett diagram or described what was shown in the genetic diagram. There was confusion between blood groups and alleles in the explanations. Candidates should note that *blood groups* are not dominant or recessive.

(ii) The correct probability, 25 %, ¼, 0.25 or 1 in 4, was given by many candidates. Common errors were 0 (zero), 0.5, 50 %, ½, 0.75, 75 %, ¾, 1, as well as ratios such as 3:1, 1:3 and 1:4.

Question 5

The syllabus states that candidates should know about the adaptations of three types of flowering plant: hydrophyte, xerophyte and mesophyte (garden plant). This question was about *Nuphar lutea* which is a hydrophyte. Fig. 5.1 showed a cross section through a leaf of this plant.

(a) Many candidates wrote a balanced equation for photosynthesis and gained full credit. Some also gave word equations that were ignored whether they were given first or second in the answer. Common errors were to give a correct balanced equation for aerobic respiration which was not credited or to not balance the photosynthesis equation correctly. Occasionally the formula for glucose was written incorrectly.

(b) Most candidates attempted the completion of Table 5.1 although occasionally some lines in the table were left blank. **B** on Fig. 5.1 shows guard cells so a common answer was the opening and closing of stomata. **C** shows palisade mesophyll so most answers concerned absorption of light or photosynthesis or both. **D** labelled a large air space in the spongy mesophyll so the best answers referred to floating or to the diffusion of gases (oxygen and carbon dioxide) through the leaf. Stomata and the air spaces labelled **D** are not sites of gaseous exchange. This happens on the surfaces of all the cells within a leaf.

(c) Candidates had to identify and then explain one way in which the leaves of *N. lutea* are adapted to the environment. General adaptations shown by all leaves were not accepted nor were whole plant adaptations such as those of the root system. The Examiners accepted the following adaptations:

- large air spaces for flotation,
- stomata on the upper surface to allow diffusion of gases to and from the air above the leaf,

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- thin cuticle as there is no need to reduce water loss by transpiration,
- flotation to maximise light absorption.

Many wrote about leaves being broad and thin without realising they were to write about adaptations to living in water. Some did not read the question and wrote about stems.

(d) The second theme in this question concerned the growth of another hydrophyte, the duckweed *Spirodela polyrhiza*. The question included results on an investigation into the effect of changing the concentration of magnesium ions in a growth medium. In **(i)**, candidates were asked to describe the effect of *decreasing* the concentration on the growth of the duckweed. Growth was measured in terms of individual plants and the colour of the leaves. Credit was available for qualitative descriptions of the data and further credit for use of the data in support. Some candidates omitted the units and so did not receive credit. Many candidates did not link their answer to the information provided in the table and answers were often imprecise. A considerable number put the answer to **(ii)** here and went on to refer to the table in **(ii)**. In **(ii)**, candidates had to explain the effects that they had described in **(i)**. Good answers explained the effects of a deficiency in terms of production of chlorophyll and the reduction in photosynthesis with less food available for growth. There were many good answers here with candidates clearly understanding the role of magnesium in chlorophyll synthesis although several confused the sequence and thought that the yellowing of the leaves was due to 'no photosynthesis' or 'poor growth'. Quite a number of candidates answered in terms of increased magnesium concentration. Frequently, answers made reference only to less growth rather than fewer plants.

Question 6

Candidates often performed well in this question on classification from ***Section I*** and natural selection from ***Section III***. The stimulus material consisted of photographs of four insect species.

(a)

(i) The binomial names indicate that insects 1 and 2 are closely related. Most candidates identified the common genus name, *Vespula*, and gained full credit. There was confusion between species, family, genus and class. Some candidates wrote 'gene' instead of genus.

(ii) Most candidates showed evidence of looking closely at the photographs and gave correct answers based on the features visible. Common answers were the two pairs of wings, the pattern of stripes on the abdomen and the similar shaped antennae. Some candidates gave very brief descriptions about the features, such as 'have wings'. There was no credit available for lists of insect features.

(b) This question introduced a mimic of *V. flavopilosa*. Candidates were asked to suggest advantages to the mimic of having a similar appearance to *V, flavopilosa* and for the most part they did this very well. Many did this in terms of a predator confusing the two species and being afraid of a non-existent sting. A number confused predator and prey.

(c) Some candidates realised that the evolution of *Chrysotoxum cautum* from a species without stripes involved mutation and selection. If they realised which 'story' to tell they almost always scored near maximum credit. Candidates who did not interpret the question correctly explained that the other species had crossed with each other to give rise to another stripy species. In other cases candidates referred to the presence of recessive genes for stripes that become evident in the phenotype as a result of breeding. No credit was awarded for this approach. Quite a few thought that there had been some genetic engineering. Some gave a Lamarckist explanation in which the stripes arose when the environment requires camouflage. In fact it was not uncommon to find answers that referred to camouflage. Some gave general answers without referring to the insect given in the question.

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Extended Theory

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General comments

The performance of candidates on the questions on this paper correlated well with their overall performance. There were some extremely good scripts, with clear answers well set out; many candidates were able to demonstrate a sound grasp of the higher level concepts demanded of these extended papers. All questions had some difficult sections but these were balanced by easier and well known parts. Therefore most candidates could gain some credit but with sufficient discriminatory parts for the stronger candidates.

Questions 1(a), 2(c) and **(d), 4(a)** and **(b)** and **5(c)** were high scoring sections for many candidates. The genetics problems in **Question 4** were well done even by candidates who gained little credit elsewhere.

Questions 1(e), 3(c)(ii), 4(e) and **5(d)** proved to be more taxing, often because these questions sought to test the application of knowledge and the interpretation of unfamiliar material presented in bar charts. Careful reading of the question stem and mark allocation was required.

There was a lack of precision in some answers. Examples were:

- blood vessels rather than arterioles in **Question 2(d)**,
- energy 'lost' without qualification in **Question 1(c)(ii)**,
- fluoride strengthening teeth rather than the enamel in **Question 5(a)**.

Comments on specific questions

Question 1

This question dealt with the energy flow in food webs linked to the practical application of ecological principles in fish farming.

(a) Most candidates were able to gain full credit, simply by picking out the correct organisms from the information given in the question stem.

(b) Many candidates correctly used the terms producer and primary consumer although some left the latter unqualified and so did not gain credit. The specific level name was required. Simply stating 1st and 2nd Level could not be credited.

(c)

(i) Light or sunlight was given by many; a common mistake was to suggest grass as the energy source for the whole web.

(ii) This question required a qualified response; energy is lost from the ecosystem to the atmosphere or is lost as heat. 'Energy is not recycled' is part of the question stem in **(d)** and cannot be used here.

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(d) Some excellent answers were seen and the concept of energy loss along a food chain was well known, often illustrated with appropriate figures. Stronger candidates also suggested how energy was lost in movement and respiration, although reference to inedible or non-digestible material was rare. Many thought that there was no energy left after the fourth trophic level rather than insufficient energy to support another level.

(e) This question required some application of the concepts outlined in **(d)** with particular reference to the increased efficiency in supplying humans with food from the lower trophic levels rather than from salmon feeding as secondary consumers. It was also expected that candidates would consider some of the wider ecological and environmental issues associated with fish farming.

Most candidates restated their generalised answers to **(d)** without applying them to the specific question of using salmon farmed in this way for human food. Many did not appreciate that it would be more energy efficient for humans to be fed from the 1st or 2nd trophic levels. Common misconceptions included the idea that salmon would naturally eat plant material, that humans would need to eat very large quantities of salmon in order to gain sufficient energy or that a diet consisting only of salmon would lead to digestive and other problems. Some did consider the possibility of disease spread between the salmon or to wild fish and the dangers of bioaccumulation of growth chemicals and pesticides.

Question 2

The topic of energy use and forms of respiration in the body was generally well known and some excellent answers were seen in all sections. However there were several examples where candidates used technical terms inappropriately.

(a) Good answers qualified the response statement, for example in describing energy use in maintaining body temperature rather than just 'heat'. Some candidates did not relate their answers to a seated, resting subject.

(b) Respiration was usually given but candidates should have noted that two marks were available here and the full response of aerobic respiration was required.

(c) The question often triggered a well-rehearsed answer from candidates and many achieved maximum credit. Oxygen debt and lactic acid production were frequently given. Weaker candidates did not always make the connection with anaerobic respiration during exercise.

(d) There were many good answers reflecting a great deal of knowledge. The best answers specified the different stages of the run and outlined the appropriate status of blood vessels and sweat glands. The role of sweat glands was well known, correctly linked to heat loss by evaporation. Changes in blood circulation during exercise gave rise to more confused answers. Movement of whole blood vessels towards or away from the skin surface was a common misconception; arterioles were mentioned only occasionally and variation in capillary rather than arteriole diameter was often seen. The term vasodilation was frequently given although it was linked to sweat glands rather than to arterioles by some candidates.

Question 3

Hormones associated with sexual development and the role of FSH in the menstrual cycle were the basis of this question.

(a) The sites of production of the main male and female hormones were generally well known, secondary sexual characteristics less so.

(b)

(i) The site of FSH production in the pituitary gland was known by many although a substantial number of candidates thought it came from the ovary.

(ii) The vast majority correctly gave the ovary as the site of egg release.

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(i) Good answers described the changes in the concentration of FSH shown in Fig. 3.1 with appropriate data quotes from the *x*-axis. Some candidates simply gave the fluctuations in levels of FSH without note of the timescale and others gave a detailed and often correct answer to **(c)(ii)**. Neither type of response was credited.

(ii) The role of FSH is perhaps the least well known of the hormones associated with the menstrual cycle and many candidates confused it with oestrogen and/or progesterone. It was often thought to be responsible for ovulation. The use of FSH in fertility treatment was also mentioned but without explaining the mechanism involved. Good answers focused on the stimulation of follicles, subsequent maturation of the egg and release of oestrogen by the follicle cells.

Question 4

The first three parts of this question dealt with a genetics problem, made slightly more difficult by the use of an example of co-dominance. The later sections concerned types of pollination and their effect on subsequent evolution. Parts **(a)** to **(c)** were often answered correctly; frequently candidates who did not perform very well elsewhere on the paper were able to demonstrate sound understanding and gain credit here. The part questions on pollination and evolution were not answered as well.

(a) The majority of candidates were able to derive the correct genotype as they had entered the correct gametes. The phenotype of orange-red was a free standing point which most achieved.

(b) The table was usually completed correctly and achieved full credit. Some candidates confused genotype with phenotype or only gave two out of the possible three genotypes for cross 2.

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(d) Good answers included a full definition of pollination with reference to transfer between anthers and stigma. Some candidates only mentioned plants instead of flowers, confused pollination with fertilisation or in a few cases confused pollination with dispersal.

(e) The responses to this question were often disappointing. The common error was to assume that self-pollination would lead to no variation as all offspring would be genetically identical. This idea tended to influence the rest of the answer. Some candidates stated that self-pollination is a form of asexual reproduction. Very few candidates realised that sexual reproduction still occurred and there would be less variation. The concept of increasing homozygosity was mentioned by a small minority, as was mutation as a possible source of variation in self-pollinators. Several answers included a failure to adapt, but did not qualify this by including references to changes in the environment. Similarly the idea of competition was recognised but not qualified by reference to local conditions.

Question 5

This question discussed the causes and progression of tooth decay, the issues surrounding the fluoridation of public water supplies and the description and extrapolation of data provided as bar charts.

(a) Good answers referred to the strengthening effect of fluoride on the enamel rather than simply reducing decay or being 'good for the teeth'. Many candidates thought that fluoride killed bacteria. Other correct responses included the availability to all and cheapness of supply. Arguments against fluoridation included reference to discolouring, taste and the lack of individual choice. Side effects of fluoridation needed to be qualified to gain credit.

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(b) This question required description of changes in sugar consumption and tooth decay in two different countries. Those who attempted to explain rather than describe the trends without reference to the data failed to score. Strong candidates handled the information well, picking out the trends and illustrating their answers by including at least two suitable figures with full units and years. Weaker answers simply described the fluctuations without reference to the time scale or misread the question and attempted to average or compare the two countries at each point.

(c) There were many good answers that showed candidates knew the sequence of events which lead to tooth decay. Most knew that bacteria react with sugar residues to form acid and that this erodes the enamel, eventually reaching the dentine. Some thought that sugar or bacteria directly damage the teeth.

(d) The question indicated that there were similarities in sugar consumption but differences in levels of tooth decay between the two countries. Candidates were asked to suggest explanations for both these phenomena. Most realised that fluoridation in Australia was likely to be a causal factor in the decline of decay in that country. Good answers also referred to levels of dental care to back up their argument in either direction. Candidates needed to respond to the clues in the question; many wrote that a similarity was that decay increased with more sugar consumption rather than using the data to point out that decay actually decreased in both areas and was independent of sugar consumption. Many repeated the description they had given in **(c)** without further explanation. Some did not see the note on the graph stating that data was unavailable at two points and assumed that tooth decay had dropped to zero in those years and then increased subsequently.

Question 6

Most of this question was based on photographs of a flower, leaf and leaf section from *Helleborus orientalis*. It was expected that candidates would make direct use of these to explain the subsequent questions as well as using their background theoretical knowledge.

(a) Good answers gave three features of dicotyledonous plants. Answers were broad leaves, reticulate venation described in a variety of ways, and five petals. Some candidates did not refer to Fig. 6.1 and included the number of seed leaves. There was occasional confusion with monocotyledons, possibly because candidates did not use the photographs.

(b) This question required the completion of a table using ticks to show which cells labelled by letters in the photograph of the leaf section were able to carry out photosynthesis. Most candidates were able to achieve partial credit by identifying the palisade and spongy mesophyll cells, but many forgot the guard cells (**F**). Some misread the question and identified all the cells in the table. Candidates were penalised for giving more than three ticks.

(c) This specifically needed candidates to use Fig. 6.2 to discuss visible adaptations for efficient photosynthesis. Many candidates were able to give suitable linked explanations, identifying for example that palisade cells had many chloroplasts to absorb as much light as possible. Simply stating that palisade cells contain chloroplasts was insufficient to gain credit for the feature as this is also true of other leaf cells. Other correct responses referred to the transparency of the epidermis, stomata, mesophyll spaces, and the proximity of the xylem, all with suitable adaptations explained. Again some candidates did not comply with the demands of the question and wrote instead about general features of leaves or leaf mosaics.

(d) Candidates who understood the process of translocation scored full credit in this question. Common errors in **(i)** were to write sugar or glucose instead of sucrose, and protein rather than amino acid. Good answers in **(ii)** used the information in the question stem and named the leaf as the source and suggested two valid sinks.

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(b) This question required description of changes in sugar consumption and tooth decay in two different countries. Those who attempted to explain rather than describe the trends without reference to the data failed to score. Strong candidates handled the information well, picking out the trends and illustrating their answers by including at least two suitable figures with full units and years. Weaker answers simply described the fluctuations without reference to the time scale or misread the question and attempted to average or compare the two countries at each point.

(c) There were many good answers that showed candidates knew the sequence of events which lead to tooth decay. Most knew that bacteria react with sugar residues to form acid and that this erodes the enamel, eventually reaching the dentine. Some thought that sugar or bacteria directly damage the teeth.

(d) The question indicated that there were similarities in sugar consumption but differences in levels of tooth decay between the two countries. Candidates were asked to suggest explanations for both these phenomena. Most realised that fluoridation in Australia was likely to be a causal factor in the decline of decay in that country. Good answers also referred to levels of dental care to back up their argument in either direction. Candidates needed to respond to the clues in the question; many wrote that a similarity was that decay increased with more sugar consumption rather than using the data to point out that decay actually decreased in both areas and was independent of sugar consumption. Many repeated the description they had given in **(c)** without further explanation. Some did not see the note on the graph stating that data was unavailable at two points and assumed that tooth decay had dropped to zero in those years and then increased subsequently.

Question 6

Most of this question was based on photographs of a flower, leaf and leaf section from *Helleborus orientalis*. It was expected that candidates would make direct use of these to explain the subsequent questions as well as using their background theoretical knowledge.

(a) Good answers gave three features of dicotyledonous plants. Answers were broad leaves, reticulate venation described in a variety of ways, and five petals. Some candidates did not refer to Fig. 6.1 and included the number of seed leaves. There was occasional confusion with monocotyledons, possibly because candidates did not use the photographs.

(b) This question required the completion of a table using ticks to show which cells labelled by letters in the photograph of the leaf section were able to carry out photosynthesis. Most candidates were able to achieve partial credit by identifying the palisade and spongy mesophyll cells, but many forgot the guard cells (**F**). Some misread the question and identified all the cells in the table. Candidates were penalised for giving more than three ticks.

(c) This specifically needed candidates to use Fig. 6.2 to discuss visible adaptations for efficient photosynthesis. Many candidates were able to give suitable linked explanations, identifying for example that palisade cells had many chloroplasts to absorb as much light as possible. Simply stating that palisade cells contain chloroplasts was insufficient to gain credit for the feature as this is also true of other leaf cells. Other correct responses referred to the transparency of the epidermis, stomata, mesophyll spaces, and the proximity of the xylem, all with suitable adaptations explained. Again some candidates did not comply with the demands of the question and wrote instead about general features of leaves or leaf mosaics.

(d) Candidates who understood the process of translocation scored full credit in this question. Common errors in **(i)** were to write sugar or glucose instead of sucrose, and protein rather than amino acid. Good answers in **(ii)** used the information in the question stem and named the leaf as the source and suggested two valid sinks.

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BIOLOGY

Paper 0610/04
Coursework

General comments

It is very pleasing to see such a wide range of excellent practical work among the samples of coursework received for moderation. Candidates entered for this Paper frequently develop practical skills of a high level. They demonstrate a good understanding of the scientific enquiry process, and develop confidence in their abilities to plan experiments, handle data and evaluate the reliability of their results.

Centres need to submit the two best marks in each of the four skills for each candidate. Some Centres use only four tasks – two assessing skills C1, C2 and C3, and another two assessing C4. (It is not possible to assess C1 and C4 on the same task.) This is perfectly acceptable, but there are considerable advantages in using a slightly larger number of assessment tasks. Firstly, it provides opportunity to use a wider range of different activities. For example, a drawing task can be used for C2, as well as tasks that involve the recording of descriptive and numerical data. Secondly, it allows a candidate to discard a poor score if they have two better ones for that particular skill. The majority of Centres therefore use between 6 and 12 tasks, generally spread over a two-year course.

There is a progression in demand from C1 to C4, and most Centres assess C1 early in the course, giving candidates plenty of opportunities to build up their C4 skills before those assessments are done towards the end of the course.

Centres are reminded that the external Moderators need to know exactly what tasks were given to the candidates. If a worksheet was used, then this should be submitted; the best way to do this is to put all the worksheets together in the sample, in the same sequence as listed on the Experiment Form. If the instructions to the candidates were oral, then a brief explanation of what they were told to do is all that is needed. Some Centres provide a little background information about the context in which the task was done (for example, any similar experiments candidates already had experience of), which is very helpful.

Similarly, the Moderators also need to know exactly how the work has been marked. It is essential that a mark scheme is constructed, and that this is submitted with the coursework sample. Mark schemes should be based firmly on the generic criteria for each of the four skills (these are found in the syllabus document), reworded to make them specific to the particular task being assessed. Most Centres do this very well, but if a Centre does not provide mark schemes it makes it extremely difficult for the external Moderators to determine whether the work has been assessed appropriately. It is also essential that each piece of candidates' work shows extensive evidence of how it has been marked, with comments from the teacher written on it, as well as a record of the marks given for each skill.

A common error made by teachers who are new to coursework assessment is to mix up the assessment of one skill with another. In most tasks, the candidate will be using parts of three or even all four skills (C1, C2, C3 and C4) when they are doing one piece of practical work. The teacher must be able to focus on one of these at a time. For example, when assessing skill C4, no attention should be paid to the collection or recording of results, as these are part of C2.

For skill C1 (Using and organising techniques, apparatus and materials) there is usually no written record of the candidates' performance, as the relevant components are ephemeral. Centres therefore need to find a way in which they can provide evidence of this performance to the external Moderator. The most common and successful way of doing this is to complete a tick list as the candidates work, recording for each candidate what was achieved and what was not.

For skill C3, care must be taken if candidates use graph-drawing programmes. It is fine for them to do this, but it is essential that they remain fully in control, making decisions about axis orientation, axis scales, how the points are plotted and how the lines are drawn. In particular, graph plotting software often defaults to a large blob for a point, whereas crosses or circles with dots in are required. It is often a good idea for

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candidates to draw at least one graph by hand, as this may be an easier way for them to show their skills in this area.

For skill C4, an important component is the control of variables. Candidates should be encouraged to make it very clear which variables they are attempting to keep constant, and how they are doing this.

Tasks for skill C4 generally work best when candidates begin with a question or a hypothesis which clearly states that they will be investigating the effect of one variable on another. For example, a task in which they are asked to 'find out how light intensity affects the rate of photosynthesis' is likely to produce a much tighter and more well-focused plan than if they are asked to do a 'photosynthesis experiment'.

This also enables them to look back at the question, hypothesis or aim when they come to write their conclusion (part of the C3 skill). A good conclusion is often a single sentence, briefly stating what the results suggest is the answer to the question, or whether the hypothesis is supported or refuted. The conclusion can then be followed by a discussion (or evaluation) in which the reliability of the results can be discussed, including reference to anomalous results, sources of error (such as the errors inherent in measuring devices, or deficiencies in the design of apparatus, rather than 'mistakes' on the part of the candidate) and how the experiment could be improved.

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BIOLOGY

Paper 0610/51

Practical Test

Key messages

- The majority of candidates showed that they were used to doing practical work. This is the best preparation for a pratical examination.
- Candidates should use the mathematical conventions as set out in the syllabus when using units or plotting graphs.

General comments

Candidates attempted all questions and showed that they had adequate time to finish the paper. The standard of English was generally good and the presentation of answers showed understanding of some questions especially with the graph plotting and drawing skills. Spelling ability varied. Poor spelling and use of language to express biological meaning created problems for candidates when trying to clearly describe or explain answers.

Some candidates experienced problems with the investigation in **Question 1**, partly caused by lack of understanding of the procedures and partly because the reaction was rapid. It was useful when marking candidates' work if the Supervisor included a report to give indications of problems that were encountered in providing materials or with procedures.

There were examples in all questions of candidates not reading the question carefully.

Comments on specific questions

Question 1

(a) Most candidates presented a clear, well organised table, constructed with ruled lines showing at least two sets of spaces to record the enzyme solution and for observations. Whether the table showed these recordings in vertical columns or horizontal rows did not matter. Both arrangements were accepted.

A few candidates introduced extra columns for observation at the start and after 10 minutes. Other candidates lifted the discs every minute and recorded the timed observations.

Most candidates observed that the starch in the plain paper in the bottom of the Petri dishes would appear blue-black with the iodine solution at the beginning. If the washing of the stained paper (at bullet point 5 of the instructions) was too vigorous, the stain was washed away.

After waiting for the 10 minute period, the starch would be converted to maltose and the plain paper would lose the blue-black colour as all of the starch had broken down in the areas under the 'soaked' filter paper discs. Candidates were expected to record their own observations in the cells shown in the table for each of the three amylase solutions, **R1**, **R2** and **R3**.

(b) Candidates were requested to explain and account for the observed changes after the 10 minute period. Firstly, that the starch had been broken down by the amylase as shown by changes to the staining by the iodine solution of the plain paper at the bottom of the Petri dishes. Secondly, that there was a difference in either the size or the colour of the areas of the plain paper beneath the three smaller filter paper discs.

R3 was expected to show a larger cleared or lighter stained area beneath the disc as **R3** solution contained a higher concentration of amylase. **R1** was expected to produce a smaller light coloured

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area as **R1** solution contained only water. **R2** solution was intermediate in amylase concentration and therefore in activity.

Amylase activity can vary. The Supervisor's Reports were important when considering the candidates' responses as many differences were recorded and the reports included accounts of problems experienced by individual Centres.

(c) Experimental planning skills were involved in this part of the question, the candidates were asked to describe how this investigation could be changed to find the effect of pH on amylase activity. It was hoped that candidates would suggest how a suitable range of pH solutions could be tested by adding these solutions to different samples of enzyme prior to soaking the small filter paper discs. It was necessary to control factors such as the concentration and volume of enzyme to be used as well as the volume of pH solution and the time these were mixed prior to soaking the discs. Practical procedures such as how the pH solution might be prepared were considered from the use of acid and alkaline mixtures. A few candidates mentioned the use of 'buffers' though this is not usually covered at this level in the core syllabus. Others included the idea of repeating the testing at each pH to increase reliability and calculating an average. Suggestions to prevent contamination of samples (such as involving a larger number of Petri dishes so cleared areas did not merge, keeping the lids on the Petri dishes or viewing the areas from beneath the dish) were considered.

It was noted that some candidates did not attempt to answer this question. Other candidates suggested using universal indicator paper or litmus paper to test pH. Although relevant to test the pH of solutions used it did not really apply to the investigation.

(d)

(i) Candidates were expected to complete two calculations of total areas after 4 and 5 minutes. Most candidates correctly calculated these two values.

Many candidates used the space below the table to show their method of calculation.

(ii) Candidates were required to plot the data from the first two columns in Table 1.1, the 'time / min' on the *x*-axis and the 'number of new areas' as the dependent variable to be shown on the *y*-axis. This should have been done as a line graph since both values were continuous.

There were a number of candidates that showed the data incorrectly in the form of a bar chart or histogram. It is important that candidates are instructed in the choice of presenting data in the correct format.

The standard of presentation of the graph was generally high. Most candidates plotted the data correctly with small neat 'x' or '+', though some candidates forgot to fully label the axes. It is important to include the units. The column headings of the Table should be used as labels. The lines joining the plotted points were usually constructed from point to point with the use of a ruler. There were a number of candidates who did not join the plotted points and others that used free hand lines which were often inaccurate.

Unfortunately, errors were noted. The wrong columns of figures were plotted – total areas v new areas or total areas v time. Axes were occasionally reversed so time was shown as the dependent variable and appeared on the *y*-axis. Some candidates used non-linear scales (i.e. equally spaced 6,12,14,18, and 28). Not all plotting was accurate.

(iii) Many candidates did not understand the meaning of this question and described the activity of amylase as though it was a timed reaction curve instead of the timed activity shown by different discs. Those able candidates who did follow the events of the investigation and the meaning of the question made reasonable suggestions based on the gender, health or diet of the goats, perhaps involving different species or races. Since the discs were placed together with the substrate (starch in the plain paper) in Petri dishes, factors such as pH and temperature controls were not applicable.

(e) Experimental planning skills were involved in this part of the question, when candidates were asked to suggest three ways to improve this investigation. Controlled variables were considered together although a few candidates gave three different ideas of controlled variables such as pH, temperature and volume of starch or saliva. A common improvement idea was based on repeating

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the samples or using a larger number of samples and calculating an average. Few candidates mentioned the idea of having a control for comparison or sampling at shorter intervals than one minute.

Question 2

(a) A photograph of one fruit with the pappus extended was shown. Most candidates' drawings had an outline of a larger fruit, carefully drawn to show the details from the photograph. A wide range of drawing standards were noted though the majority showed clear outlines of a larger fruit with an attempt to show the hairs forming the parachute. It was difficult to gauge the proportion for the size of the seed in relation to the 'stem' of the pappus and the seed was often drawn too large. It was noted that several candidates appeared to use ruled lines for the 'stem' part and there was no overlap of the lines where the ruled ends did not merge with the rest of the outline. To illustrate the attachment of the fruit to the plant a number of candidates showed the whole flower head with three or more fruits *in situ.* A small number of atypical drawings were noted that did not bear any resemblance to the structures shown in the photograph.

Able candidates showed both labels correctly positioned but there was a variation in the interpretation of the position of the seed by other candidates who often located the seed incorrectly in the centre of the pappus head. Label lines must be precise, make contact with the structure concerned and not end several millimetres away.

(b)

(i) Overall this was well done and measurements were accurate, recording the unit used as either mm or cm. The units were only omitted by a few candidates. A few candidates need to be advised to use metric units of measurement and not imperial units such as inches. Although many candidates showed a line drawn next to their drawing or a box surrounding their drawing, sometimes these did not accurately represent the length of the drawn fruit.

(ii) Many candidates correctly worked out the magnification of their drawing. The most common errors were to present their answer either without an 'x' or with units or with both 'x' and units. A minority incorrectly worked out the percentage.

(c)

(i) Two photographs of the fruit under dry and damp conditions showed the pappus extended and closed respectively. Although only a few candidates were familiar with the term 'pappus', most candidates noted the difference in arrangement of the parts and referred to them as 'hairs', filaments or other terms. A wide range of alternative terms were considered as well as alternative words for extended or grouped/clumped together.

(ii) Candidates were expected to link the weather conditions using the parts of this question to explain how different dry, windy or damp/rainy conditions might aid dispersal and eventual germination of these single seeded fruits. This was well answered by able candidates.

If the germination details were included this enabled the marking points to easily gain the full credit available for this question. Unfortunately, many candidates restricted the explanation only to dispersal of the fruits and some candidates were confused over wind-pollination of flowers instead of fruit dispersal.

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BIOLOGY

Paper 0610/52
Practical Test

Key messages

- The majority of candidates showed that they were used to doing practical work. This is the best preparation for a pratical examination.
- Candidates should ensure that they have a sharp pencil and good eraser to enable them to produce clear Biological drawings.

General comments

Candidates attempted all questions and showed that they had adequate time to finish the paper. The standard of English was generally good and the presentation of answers showed understanding of some questions especially with the graph plotting and drawing skills. Spelling ability varied. Poor spelling and use of language to express biological meaning created problems for candidates when trying to clearly describe or explain answers.

It was necessary for candidates to read the instructions carefully before beginning each question so that they understood what they had to do. It seemed that most candidates did do this.

Candidates should aim to describe exactly what they did, or observed. They should avoid vague words like 'amount' and instead, use 'volume' or 'mass' as appropriate. Neat tables, accurate well planned graphs and clear drawings could all have helped to convey the candidates' results and observations in this examination.

Where the results were not as expected, the Supervisors' Reports were essential for the Examiners to understand what had gone wrong.

Comments on specific questions

Question 1

(a) Most candidates carried out the experiment successfully. They made neat tables to record their results. Good tables had a heading for the column for the number of drops of iodine solution used. Then 'drops' did not have to be re-written three times in the table. It was only necessary to record the number of drops of iodine solution to reach the end point for each of the three vitamin C solutions.

Some candidates added unnecessary extra rows or columns to describe colour changes as the drops of iodine solution were added and the disappearance of the blue colour when the mixture was shaken. Perhaps these candidates thought that 'observations' meant all the things they could see. It was not necessary to put these changes in the table nor the volumes of starch solution or of the vitamin C solution since these were the same in each case. Here the most important observation was the number of drops of iodine solution.

The number of drops recorded varied within Centres. They were not always in the expected order and not always the same as the Supervisor's results. Some candidates might have shaken the mixture too hard. The instructions said "gently". Vigorous shaking caused the blue colour to disappear again because oxygen entered from the air.

(b) Able candidates realised that **S1** was more concentrated than **S2** and that **S2** took more iodine solution to reach the end point than did **S1.** These candidates were able to reason the possible vitamin C concentration of solution **S3.**

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Less able candidates thought that the more concentrated vitamin C solution would need less iodine solution. A small minority persisted in this even when their results suggested otherwise. Possibly they confused the position of the decimal point. **S1** with 0.2 % vitamin C was four times as concentrated as **S2** with 0.05 %.

Although not all candidates were able to explain clearly how they deduced the concentration of **S3**, their meaning was usually clear. Some wrote that **S1** took longer to change, when they really meant it took more drops. If the iodine solution had been very dilute they might have needed large numbers of drops. Large numbers take longer to deliver. Maybe this gave rise to the idea that less concentrated vitamin C solutions become blue "more quickly" than more concentrated ones and vice versa. Almost all candidates gained credit for their estimate of the concentration of **S3**.

(c) This question asked for four ways in which they could "improve this method". The suggestions to use DCPIP (dichlorophenolindophenol) instead of iodine solution is a different method. It did not answer the question. Using an apparatus like a burette, which could measure the total volume of iodine delivered drop by drop, was a good suggestion. The volume could be read from the burette at the beginning and again when the end-point was reached. Another improvement was to have made further tests on solutions of vitamin C of known concentrations between 0.2 % and 0.05 %.

Repeating each test and making an average of the numbers of drops of iodine solution in order to increase reliability, were good improvements suggested most frequently.

Candidates have been taught to control variables and here the volumes and concentration of the starch and iodine solutions should be the same for all concentrations of vitamin C. The volume of vitamin C itself should be the same. Candidates should avoid using the word "amount" which is imprecise. Measuring volumes and concentrations exactly was not quite right. It was making the volumes and concentrations the same that was important. Temperature and pH were not relevant this time because they were unlikely to change during the experiment.

Other good suggestions were to avoid mixing solutions by using new, clean tubes or separate pipettes, for each one, or washing them thoroughly with distilled water. Using larger samples would take more drops of iodine solution and increase the difference between them. The use of a white card behind the test tube to show the colour clearly or a blue card to show the shade of blue at endpoint, were also good suggestions that were less frequently offered.

(d)

(i) Nearly all the candidates gained full credit for constructing a bar chart to compare the vitamin C concentration of the five fruits. It was extremely rare to see a chart with the axes reversed or not properly labelled. Almost all the charts drawn were neatly ruled, accurate and used all of the grid. The columns should have been separated because the juices were separate kinds. It was not necessary to shade them or to write a key if the juices were named on the *x*-axis. Line graphs were not suitable because although the drops of iodine were numerical and continuous, the blackcurrant, orange, strawberry, pineapple and lemons from which the juices were obtained, were not.

(ii) Nearly all candidates recognised that blackcurrant juice had the highest concentration of vitamin C.

Some candidates might have remembered course work with DCPIP where fewer drops meant higher concentration of vitamin C. It did not apply here.

(iii) By far the majority of candidates explained clearly that the higher the concentration of vitamin C, the more drops of iodine solution were used and blackcurrant juice took the highest number of drops.

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Question 2

(a)

(i) There were some excellent large drawings made with clear thin lines and no shading. Candidates need to be reminded to have well sharpened pencils and good erasers so that they can correct mistakes. A very few candidates used pen and so could not correct errors. Some candidates used heavy shading which is not useful in biological drawings.

There was most variation in the proportions of the larva from long and thin to short and fat. Many drawings represented the hair-like spines accurately, including the places where there were two together. Other candidates either left the appendages out or exaggerated them.

(ii) Nearly all candidates measured the length of the larva in the photograph accurately.

Some candidates drew lines across the top of the head and the tip of the tail to measure the length of their drawings of the larva. They should be reminded that the lines have to be parallel and in this case, at right angles to the midline of the larva. Even within the space allowed for the drawing in this question, lines which were not quite parallel could be several milimetres out.

(iii) There were more mistakes here than in the measurements. A substantial minority of candidates forgot to put in the 'x' sign. Rather fewer candidates got the formula the 'wrong way up'. Candidates need to be reminded that if the magnification is less than 'times one' the drawing is smaller than the original image. In this question they were asked to make a large drawing and almost no candidates made a drawing that was smaller than the photograph. All candidates should have found a magnification greater than x1.

Some candidates put a percentage sign after the magnification. A small number of candidates subtracted the larger measurement from the smaller. These were both wrong.

(b)

(i) Candidates seemed reluctant to make marks on the photograph of the leaf. It would have helped them to calculate the area of the leaf. Little ticks and crosses or dots in squares would have assisted greatly.

Some candidates used the area of the whole grid for the area of the leaf.

Finding the area damaged by the larvae was harder. It was necessary to draw round each tunnel and make an estimate of the number of part squares involved. Relatively few candidates showed any indication of how they arrived at the area of the leaf or the area of damage.

(ii) Most candidates realised that the midrib would be tough and most of them said that the xylem in it would make it impossible for the larvae to eat through it. A small number of candidates thought that the larvae were careful not to harm the leaf. Very few commented on the more easily eaten lamina or mesophyll.

(iii) There were some good answers to this question but only a minority of candidates gained full credit. Most candidates mentioned that the area for light absorption and therefore photosynthesis would be reduced by the tunnels or that photosynthesis would be reduced because palisade mesophyll was eaten by the larvae. If the palisade tissue was eaten the number of chloroplasts would be reduced. Less common was the statement that the leaf might dry out because of damage to the stomata, loss of water supply through damaged small veins or increased evaporation through the tunnels. Very few candidates mentioned that the leaf could be infected by pathogens entering through the tunnels.

(c)

(i) The best answer here was "jointed legs". This is the feature that gives arthropods their name and the jointed legs were clearly visible in the photographs of the moths. Some candidates confused segments with joints in limbs. A small number of candidates thought that there were two different moths and compared them. It seemed that a lot of candidates thought that the stripes on the closed wings were segments.

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(ii) A large proportion of the candidates correctly stated three pairs of legs as a feature used to classify the moth as an insect. Three pairs of legs could clearly be seen in Fig. 2.3. Rather fewer candidates mentioned the pair of antennae visible in both photographs and fewer still the two pairs of wings which could be seen in Fig. 2.4. A lot of candidates named the limbs but forget to write how many there were.

Three body parts, head, thorax and abdomen was another insect feature which could be seen in Fig. 2.4.

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BIOLOGY

Paper 0610/61
Alternative to Practical

Key messages

- Most candidates were able to produce large outline drawings and they had clearly practised this skill.
- Care needs to be taken over the correct use of terminology. For example, candidates often used the terms cover slip and microscope slide interchangeably.
- Candidates should use the mathematical conventions as set out in the syllabus when using units or plotting graphs.

General comments

The standard of English was generally good and the presentation of answers showed understanding of some questions especially graph plotting and drawing skills. A range of spelling ability was noted. Poor spelling and use of language to express biological meaning created problems for candidates when trying to clearly describe or explain answers.

Candidates had difficulty with the investigation in **Question 1**. Many did not seem to comprehend the process of starch breakdown in the plain paper by amylase in the 'soaked' small filter paper discs.

There were examples in all questions of candidates not reading the question carefully. Candidates attempted all questions and showed that they had adequate time to finish the paper.

Comments on specific questions

Question 1

(a) Most candidates stated that the starch in the plain paper in the bottom of the Petri dishes would appear black or blue with the iodine solution.

(b) It was expected that candidates would describe the observed colour change as paler blue-black or the colour of the iodine solution (yellow-brown).

Although many candidates were familiar with the expected positive colour of starch when tested with iodine solution, only a few described the actual colour for the expected reaction when the starch had broken down.

(c)

(i) Candidates were expected to complete two calculations of total areas after 4 and 5 minutes. Most candidates correctly calculated these two values.

Many candidates used the space below the table to show their method of calculation.

(ii) Candidates were required to plot the data from the first two columns in Table 1.1, the 'time / min' on the *x*-axis and the 'number of new areas' as the dependent variable to be shown on the *y*-axis. This should have been done as a line graph since both values were continuous.

There were a number of candidates that showed the data incorrectly in the form of a bar chart or histogram. It is important that candidates are instructed in the choice of presenting data in the correct format.

The standard of presentation of the graph was generally high. Most candidates plotted the data correctly with small neat 'x' or '+', though some candidates forgot to fully label the axes.

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It is important to include the units. The column headings of the Table should be used as labels. The lines joining the plotted points were usually constructed from point to point with the use of a ruler. There were a number of candidates who did not join the plotted points and others that used free hand lines which were often inaccurate.

Unfortunately, errors were noted. The wrong columns of figures were plotted – total areas v new areas or total areas v time. Axes were occasionally reversed so time was shown as the dependent variable and appeared on the *y*-axis. Some candidates used non-linear scales (i.e. equally spaced 6,12,14,18, and 28). Not all plotting was accurate.

(iii) Many candidates did not understand the meaning of this question and described the activity of amylase as though it was a timed reaction curve instead of the timed activity shown by different discs. Those able candidates who did follow the events of the investigation and the meaning of the question made reasonable suggestions based on the gender, health or diet of the goats, perhaps involving different species or races. Since the discs were placed together with the substrate (starch in the plain paper) in Petri dishes, factors such as pH and temperature controls were not applicable.

(d) Experimental planning skills were involved in this part of the question, when candidates were asked to suggest three ways to improve this investigation. Controlled variables were considered together although a few candidates gave three different ideas of controlled variables such as pH, temperature and volume of starch or saliva. A common improvement idea was based on repeating the samples or using a larger number of samples and calculating an average. Few candidates mentioned the idea of having a control for comparison or sampling at shorter intervals than one minute.

Question 2

(a) Drawing the whole of one fruit shown with the pappus extended was requested. Most outlines showed a larger fruit carefully drawn to show the details from the photograph. A wide range of drawing standards were noted, though the majority showed clear outlines of a larger fruit with an attempt to show the number of hairs forming the parachute. It was difficult to gauge the proportion of the size for the seed in relation to the 'stem' of the pappus. These structures were often drawn too large. It was noted that several candidates appeared to use ruled lines for the 'stem' part and there was no overlap of the lines where the ruled ends did not merge with the rest of the outline. To illustrate the attachment of the fruit to the plant a number of candidates showed the whole flower head with three or more fruits *in situ.* A small number of atypical drawings were noted that did not bear any resemblance to the structures shown in the photograph. Able candidates showed both labels correctly positioned but there was a variation in the interpretation of the position of the seed by other candidates who often located the seed incorrectly in the centre of the pappus head.

(b)

(i) Overall this was done well and measurements were accurate, recording the unit used as either mm or cm. The units were only omitted by a few candidates. A few candidates need to be advised to use metric units of measurement and not imperial units such as inches. Although many candidates showed a line drawn next to their drawing or a box surrounding their drawing sometimes these did not accurately represent the length of the drawn fruit.

(ii) Many candidates correctly worked out the magnification of their drawing. The most common errors were to present their answer either without an 'x' or with units. A minority incorrectly worked out the percentage.

There were a minority of candidates who manipulated their measurement for the fruit they drew to make the calculation of the magnification easier to work out. Although most measurements were accurate, some did not relate to the length of their drawing.

(c)

(i) Although only a few candidates were familiar with the term 'pappus', most candidates noted the difference in arrangement of the parts and referred to them as 'hairs' or 'filaments'. A wide range of alternative terms were considered as well as alternative words for extended or grouped/clumped together.

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(ii) Candidates were expected to link the weather conditions using the parts of this question to explain how different dry, windy or damp/rainy conditions might aid dispersal and eventual germination of these single seeded fruits. This was well answered by able candidates.

A few candidates mentioned the negative side of damp/rainy conditions preventing the dispersal of the fruits.

Unfortunately, many candidates restricted the explanation only to dispersal of the fruits and some of these candidates were confused over wind pollination of flowers instead of fruit dispersal.

Question 3

(a)

(i) The possession of a light coloured outer layer on the stem was the similarity that was often given, even if various alternative names were used to describe this structure such a skin or rind.

(ii) The differences between the ginger and lotus stems were more visible and many candidates commented on the large holes present in the lotus stem. Other differences included the shape of the sections of the stems, the outer layers and the fibrous structure of the ginger stem. It was impossible to view the xylem and phloem in these sections as they were not sufficiently magnified.

(b) The large holes that were visible as dark areas in Fig. 3.1 supported that this plant lived in water even if the lotus plant was unknown to candidates. These are for gases, not for transport of water, and so enable the stem to float as the stems are buoyant. Alternative ideas of smooth surface and flexible stems were considered. Candidates must ensure that they only use features that are clearly visible from the photograph.

(c) The preparation of a microscope slide, to show the presence of starch grains in a root or stem of the lotus plant, was a planning skill that many candidates described correctly. The plant material needed to be sectioned though some candidates preferred to crush and grind the material to extract the starch grains. The plant material needed to be placed on a microscope slide and stained with iodine solution to show that the grains were composed of starch. The preparation needs to have a cover slip placed carefully (so air bubbles are not trapped) and then viewed with magnification to identify the starch grains. Able candidates who had practised this procedure described it clearly.

Some candidates prepared a slide without describing any staining procedure and others only described the staining with iodine solution and the expected result for starch. Use of the terms for slide and cover slip were often vague as though these terms were not known.

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BIOLOGY

Paper 0610/62
Alternative to Practical

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- Most candidates were able to produce large outline drawings and they had clearly practised this skill, although shading should be avoided.
- Care needs to be taken over precision in answers and the correct use of terminology. For example, candidates often gave general arthropod features when asked for specific insect features.
- Candidates should use the mathematical conventions as set out in the syllabus when using units or plotting graphs.

General comments

The standard of English was good and, overall, the candidates showed they were able to present results and handle experimental data satisfactorily.

Candidates attempted all questions and showed that they had adequate time to finish the paper.

Comments on specific questions

Question 1

This question was based on an experiment to determine the concentration of vitamin C (ascorbic acid) in an unknown solution, **S3**. The starch solution and vitamin C are mixed together and then iodine solution is added, drop by drop. The iodine in the mixture will react with the vitamin C. The blue black iodine complex, usually formed with the starch solution, will not appear until all of the vitamin C has reacted with the iodine solution. The result shows a positive correlation, the more drops added, the higher the concentration of vitamin C. The candidates were given results for two known concentrations of vitamin C and the number of drops of iodine solution used for **S3**. From these they were asked to suggest the vitamin C concentration of **S3**. Candidates were not expected to be familiar with this particular investigation but it was intended to test their ability to present results, handle data and make suggestions for improving experimental procedure.

(a) The table should be a totally enclosed box, drawn with ruled lines and containing discrete spaces for the headings and the results.

The solutions and number of drops of iodine solution could have been included as rows or columns. Headings should be complete with units, and no units should be in the spaces with the results. The heading for the iodine solution needed to include 'drops' as they were equivalent to units. The other heading was for the solutions **S1**, **S2** and **S3**; % concentration of vitamin C was accepted as an alternative heading for the solutions but again % should only be written in the heading.

The results for the number of drops were to be calculated from the tally chart and should have been written as numbers only.

The majority of candidates produced a neat, complete table but a small number did not subdivide the results into separate rows and displayed them in an open box while others incorrectly put their headings outside the table. Incomplete tables with no side or top lines or tables with extended lines beyond the enclosed cells were not given credit.

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The most common error was to use an incomplete heading for the number of drops of iodine solution. Number of drops alone was insufficient and it is not possible to have drops of iodine. Drops and % were quite often incorrectly written with numbers in the table.

Most values were correct but a small number of candidates did not understand that each crossed group of lines on the tally chart represented 5 drops; some candidates added them up as 4 drops. Some candidates incorrectly used the tally instead of number of drops in their table.

(b) Many candidates correctly worked out that **S3** would have a concentration between 0.09% and 0.11%. As the candidate was asked for an approximate concentration then credit was given if the candidate correctly indicated the **S3** concentration in relation to **S1** and **S2** without an actual value.

More able candidates gave their reasoning to gain further credit.

The number of drops of iodine solution used had to be taken into account to work out the approximate concentration of **S3**. Most candidates referred to the 11 drops used or identified the number in terms of half the number of drops used by **S1** or twice the number of drops used by **S2**. Just stating that the number of drops was between those for **S1** and **S2** was not given credit here.

There were some very good answers. Using 11 drops and one set of the results given for either **S1** or **S2**, (concentration and number of drops), it was possible to work out the percentage concentration for **S3** e.g. Concentration **S3** = concentration of **S1** / number of drops **S1** x number of drops **S3** [0.2 / 22 x 11]. More able candidates used this formula. Others used the ratio of drops **:** concentration i.e. approximately 1 drop **:** 0.01%.

(c) This question was not well answered. Most candidates did not look carefully at the experimental procedure outlined in the introduction so that they could give improvements that would specifically apply to this method. Too many suggestions were general and would, in fact, have made little difference to the actual results.

Most candidates gained credit for the ideas of repeating the experiment and finding the average. A small number confused the idea of repeat and said, incorrectly, that they would repeat the experiment with different vitamin C values.

Very few candidates mentioned the idea of measuring the volume of iodine solution rather than counting the number of drops. The use of an instrument e.g. burette or syringe, to deliver the iodine solution more accurately was seen, but very occasionally.

The end point of the experiment was a definite colour change and so it would improve the experiment if a precise instrument like a colorimeter was used. More simply the use of a white tile or card placed behind the tube would help the more accurate recognition of the end point. Only a small minority of candidates thought of this.

It would have improved the accuracy of the estimated concentration for **S3** if more intermediate concentrations between 0.2 % and 0.05 % vitamin C concentrations had been used. Many candidates did suggest using more concentrations but, in fact, the number of drops used for **S3** were between those used for **S1** and **S2** so it would be of no benefit to increase the concentrations above 0.2 % or below 0.05 %. This was quite a difficult concept but a small number of more able candidates did give it.

In this experiment certain variables had to be controlled. It was important to maintain a constant concentration or batch of the iodine or starch solutions. Another alternative for the same idea was to use the same sized test tubes and this was seen fairly frequently. This was important as the end point of the experiment was a specific colour change and the depth of colour would vary when viewed in different sized tubes. The same apparatus on its own was considered too vague for this point. The most common error was to suggest using the same volumes of starch and iodine solutions but these were the same in the original experiment. Same amounts of iodine or starch were too vague.

There were many incorrect examples of using the same concentrations of vitamin C or the same number of drops of iodine which missed the point of the experiment. Stirring all the solutions was considered inappropriate as it would alter the end point. Another common error was to suggest keeping a constant temperature.

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One other incorrect idea seen quite frequently was to use the DCPIP test. This is a different investigation to determine Vitamin C concentration so cannot be considered as an improvement. A small number of candidates described safety features e.g. use of goggles or tying hair back. Safety features were not required to improve this investigation.

(d)

(i) Candidates were asked to plot the results of a similar investigation into the concentration of vitamin C in five fruit juices. As the types of fruit juice were discrete categories and the number of drops of iodine solution was a numerical dependent variable, a bar chart was the appropriate graphical form. A number of candidates incorrectly presented the data as histograms and line graphs. Histograms show the variation in a sample of repeated measurements separated into classes or groups. Line graphs are used when both variables are continuous with interval data.

The type of fruit juice should be on the *x*-axis and the number of drops of iodine solution should be on the *y*-axis. Most candidates correctly orientated their graph and labelled the axes appropriately. The name of the fruit juice should be centrally placed under each column and as the results that the candidates were working from only gave number of drops, this was allowed as a suitable label for the *y*-axis.

Candidates were required to use more than half of the available grid to present their graph. The axes should be evenly spaced so that the points plotted make full use of the grid. This was well done by most of the candidates using the scale of 1 small square to 1 drop of iodine solution on the *y*-axis.

The majority of the candidates plotted the columns accurately, very few errors were seen. The columns should be of equal width with a space between the columns. Most columns were neatly drawn with a ruler. A small number of vertical line graphs were drawn. Shading of the columns and keys were unnecessary but frequently seen.

(d)

(ii) The majority of candidates recognised blackcurrant as the juice with the highest concentration of vitamin C as it used the most drops of iodine solution. This had to be interpreted from the given data and not prior knowledge. The most common error was to choose pineapple as candidates confused the interpretation of the results with those of the DCPIP test where the least number of drops represented the highest concentration.

Question 2

(a)

(i) Overall the drawings were of a high standard. Most candidates showed the outline with a continuous single line. Very few outlines were sketchy but a large number of candidates were not awarded credit here because they tried to show details from the photograph with shading. This is not acceptable and the details should be represented by outline only.

Most larvae were drawn larger than the photograph.

The majority of drawings of larvae showed the correct number of segments (twelve). The most common error was to draw segments as incomplete rather than discrete units.

There were clear pigmented areas on each segment. Most candidates identified and drew these but many were heavily shaded and this was not necessary.

Most candidates correctly drew the appendages seen on each segment.

(ii) Overall this was well done and measurements were accurate, recording the unit used as either mm or cm. The units were only omitted by a few candidates. There were a minority of candidates who manipulated their measurement for the larva they drew to make the calculation of the magnification easier to work out. Although most were accurate, some measurements did not relate to the length of their drawing.

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(iii) Many candidates correctly worked out the magnification of their drawing. The most common errors were to present their answer either without an 'x' or with units. A minority incorrectly worked out the percentage.

(b)

(i) It was expected that the candidates would attempt to count the number of squares and parts of squares occupied by the entire leaf and the tunnels. Quite a number of candidates did show this method by either marking the squares on the leaf or counting up squares and parts of squares in their working. More often it was the less able candidates who tackled the problem methodically and gained credit for showing this working. Others left the leaf and grid blank and relied on estimation. Those candidates who showed that they had used the grid usually produced more accurate areas of leaf and tunnels. A large range of areas were accepted for the final tunnel area as the measurement depended upon whether candidates had concentrated on the very dark obvious damage or included the paler areas of damage around it. A common error was to give the total area of the grid as the leaf area. The majority of candidates applied the correct formula, i.e. area of tunnels / total area of leaf x 100, to calculate the percentage damage.

(ii) Most candidates gained credit for a correct reference to the midrib being too hard or tough to eat through. More able candidates continued to explain that it was tough owing to the presence of xylem which was thickened by lignin. Another possible explanation was the idea that the larva would find it easier to get food from the rest of the softer leaf blade or mesophyll tissue so making tunnels there rather than through the tough midrib. This was rarely seen. Those candidates who attempted this usually made vague references to leaf tissue. This was inaccurate because leaf tissue would include the midrib.

(iii) Many candidates were able to gain full credit here. There were many correct answers describing a reduction in photosynthesis linked to reduced leaf tissue. A common error was to state that the larvae ate all the food rather than the knowledge that the leaf makes its own food. The able candidates also made correct references to the leaf drying out, either the leaf losing too much water or the leaf being unable to get enough water as a result of vein damage. There were many vague references to nutrients. A small number of candidates correctly identified that the leaf would be more likely to become infected. A common error was to state that the larva would weaken the leaf and become too heavy causing the leaf to drop off.

(c)

(i) The most obvious visible feature from the photographs is its jointed legs. Many candidates correctly identified this. Another common answer was segmented body and this was given credit, although it was not so obvious. Weaker candidates incorrectly quoted an exoskeleton, which could not be seen. Other incorrect answers included three pairs of jointed legs or wings which are features of insects rather than all arthropods.

(ii) This part was not well answered. Answers were not specific and although the features listed included pairs of legs, antennae and wings, the candidate did not realise that the classification of insects is dependent upon specific numbers of these structures which could be seen in the photographs. Although having three pairs of legs was fairly well known, only the able candidates could identify two pairs of wings and one pair of antennae. Three body parts or head, thorax and abdomen were quite well known but three segments on its own was not accepted. A common error was to say compound eyes but these were not visible on the photographs.

Question 3

(a) Almost all candidates were able to observe the change in **B** and correctly stated that the pupil was dilated or had increased in diameter.

(b) The explanations for the pupil increasing in size were much less well answered. Most candidates were only awarded partial credit for a correct reference to it being a result of a reduction in light intensity. Of those who went on to attempt to explain the mechanism, only a small number of able candidates identified circular and radial muscles and how these muscles responded to dilate the pupil. A common error was to describe accommodation and try to link the increase in size of the pupil to the ciliary muscles and suspensory ligaments and /or near and distant vision.

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