BIOLOGY

Paper 0610/11
Multiple Choice

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

General comments

Candidates coped extremely well with this paper. Candidates seemed well prepared for this type of examination and had studied the full breadth of the syllabus.

Comments on Specific Questions

Question 3

Although candidates found this an easy question, it served to indicate that there is a sound understanding of the basic fact that chloroplasts are structures not associated with animal cells.

Question 7

It requires careful thought before deciding whether any particular structure is a tissue or an organ. This question required that careful thought, which had to be related to a structure that many candidates might not previously have considered in these terms. Those who did well on the paper as a whole displayed quite impressive knowledge and understanding in selecting the correct option.

Question 17

This question revealed a fundamental misunderstanding for some candidates. A proportion of the candidates appeared unaware that the hormone insulin is carried by the blood, as they suggested that it would leave the pancreas via the pancreatic duct.

Question 20

This question emphasised the need to be able distinguish between the two types of respiration in humans, and to always read the question carefully before answering. Many candidates either confused aerobic and anaerobic respiration or did not read the question carefully enough.

Question 32

When answering questions of this nature candidates must be taught to look at all possible impacts on the food web and then read all of the possible answers carefully. The most popular answer was that to remove carnivores from a food chain would be likely to decrease the number of top carnivores, but this option clearly indicated that this would be the *only* effect. Candidates thus did not take their reasoning one step further to realise that the number of herbivores would increase, thus decreasing also the number of producers on which they feed.

Question 36

This question highlights a common area of confusion for candidates, which points to the need for greater emphasis from teachers as to the difference between respiration and photosynthesis in plants. Many candidates believed that glucose and oxygen are products of respiration in green plants.

Question 37

This question proved to be the best answered on the paper. Candidates have clearly understood the impact of a species being introduced to a new area and the idea that there would be no naturally occurring predators.

BIOLOGY

Paper 0610/12
Multiple Choice

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

General comments

Candidates coped extremely well with this paper. Candidates seemed well prepared for this type of examination and had studied the full breadth of the syllabus.

Comments on Specific Questions

Question 1

This proved to be the best answered question on the paper. Given that candidates had to manipulate five of the characteristics of living organisms to arrive at the correct answer, it was most creditable that so many did so.

Question 7

This question required candidates to apply a definition to a situation with which they may not have been entirely familiar. Through careful analysis of the image, they should have been able to deduce that as the capillary had two different types of cells, it was an organ rather than a tissue (which was selected by many candidates).

Question 20

Candidates clearly understood the idea that smoking can paralyse cilia. What was less well understood was that it can also lead to increased mucus production. This point should be emphasised when teaching this topic.

Question 25

Candidates must ensure that they read each question carefully. This question referred to a pregnant woman's blood, but a large proportion of the candidates appeared to answer the question as if it related to the blood of a foetus.

Question 28

When preparing candidates for the IGCSE Biology examination papers, it is essential that teachers give candidates experience of interpreting graphical information. This question focused on an area of the syllabus that is often misunderstood, germination and seedling growth. Those candidates who had received less exposure to graphical exercises in the course of preparation for this examination may have struggled with this question.

Question 36

This question highlights a common area of confusion for candidates, which points to the need for greater emphasis from teachers as to the difference between respiration and photosynthesis in plants. Many candidates believed that glucose and oxygen are products of respiration in green plants.

Question 37

When answering questions of this nature candidates must be taught to look at all possible impacts on the food web and then read all of the possible answers carefully. The most popular answer was that to remove carnivores from a food chain would be likely to decrease the number of top carnivores, but this option clearly indicated that this would be the *only* effect. Candidates thus did not take their reasoning one step further to realise that the number of herbivores would increase, thus decreasing also the number of producers on which they feed.

BIOLOGY

Paper 0610/13
Multiple Choice

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

General comments

Candidates coped well with this paper. Candidates seemed reasonably well prepared for this type of examination and had studied the full breadth of the syllabus.

Comments on Specific Questions

Question 8

It requires careful thought before deciding whether any particular structure is a tissue or an organ. This question required that careful thought, which had to be related to a structure that many candidates might not previously have considered in these terms. Those who did well on the paper as a whole displayed quite impressive knowledge and understanding in selecting the correct option.

Question 11

This question emphasised the need for careful thought before answering. The question asked for a characteristic, not of an enzyme, but of a *catalyst.* Many candidates opted for the answer that they are made of protein, indicating that they had mis-read the question.

Question 13

Candidates must be taught the differences in structure between the various types of blood vessel, including presence or absence of valves. Many did not realise that the renal vein was the only vessel present with valves.

Question 17

When covering the circulatory system, teachers must ensure that a common area of misunderstanding (the identity of the blood vessels entering and leaving the heart) is emphasised. That area was tested in this question, with many candidates confusing the pulmonary artery and pulmonary vein.

Question 19

In order to prepare candidates for the IGCSE Biology examination papers, it is necessary for teachers to make use of graphical information. Candidates need to be able to interpret graphical information using their biological knowledge. Such practise would have assisted candidates with this question.

Question 29

When answering questions of this nature candidates must be taught to look at all possible impacts on the food web and then read all of the possible answers carefully. The most popular answer was that to remove carnivores from a food chain would be likely to decrease the number of top carnivores, but this option clearly indicated that this would be the *only* effect. Candidates thus did not take their reasoning one step further to realise that the number of herbivores would increase, thus decreasing also the number of producers on which they feed.

Question 33

This question highlights a common area of confusion for candidates, which points to the need for greater emphasis from teachers as to the difference between respiration and photosynthesis in plants. Many candidates believed that glucose and oxygen are products of respiration in green plants.

Question 38

This question proved to be the best answered on the paper. Candidates have clearly understood the impact of a species being introduced to a new area and the idea that there would be no naturally occurring predators.

BIOLOGY

Paper 0610/21

Core Theory

Key Messages

It is vital that candidates read each question carefully and carry out the task required. The command words "state", "explain" and "suggest" each require a different type of response. The syllabus contains a glossary of terms used in science papers and this should be referred to when preparing candidates for these assessments.

It is preferable to avoid wasting time copying out part of the question stem. This was done by many candidates this series.

Candidates should be taught and learn definitions of key terms as they are given in the syllabus. Some processes, for example, transpiration, are very difficult for candidates to explain in their own words, and marks are more accessible if the correct phraseology is known.

General Comments

The majority of candidates performed well on this paper. Only a few candidates gained very low scores and a large number performed excellently and were awarded high marks. There was no evidence that candidates had found the time allowed too short. Some answers were left blank, and this seemed to be through lack of knowledge rather than lack of time.

Some weaker candidates may perform better if they try to give, for example, three distinct points in their answer to a question carrying three marks. It would appear that weaker candidates are satisfied having given one fact, when three were required. Candidates should be taught to target the length of their response and the number of response points given to the number of marks available. There were some areas where specific improvements can be made, and these will be clarified in the relevant sections.

Comments on Specific Questions

Question 1

Most candidates used the key proficiently and gained full marks. A few of the weaker candidates attempted to give common names for the mammals shown, ignoring the instruction to use the key.

Question 2

(a) (i) – (iii) Candidates could extract information accurately from the graph and the majority gained full marks. Sometimes rhinoceros was incorrectly selected instead of elephant in **(iii)**.

(a) (iv) The majority of candidates extracted the correct information from the graph. A large number then proceeded to carry out a subtraction using their figures and not a division as was required. Identification of the correct data from the graph carried partial credit.

(b) The relationship between body mass and heart rate was recognised by nearly all candidates. Excellent answers stated that the relationship between body mass and heart rate was inversely proportional.

(c) The red blood cell and its function were generally well known. Although the white blood cell was usually identified correctly, candidates tended to describe its functions using unscientific terminology. Descriptions such as "fighting germs" and "defending the body against bad cells"

were not given credit. More proficient candidates were able to refer to phagocytosis or antibody production. The plasma was the least well recognised blood component and few were able to give the role of the plasma in terms of transport.

(d) Candidates should be taught to be able to identify on a diagram the major blood vessels. The vena cava was frequently incorrectly identified as the aorta.

(e) Many candidates achieved full marks for this question part. Better answers were in the form of an account that was sequential, as opposed to a list of unlinked statements. A common misconception for the weaker candidates was to refer to breathing rather than respiration.

Question 3

(a) Nearly all candidates followed the instructions and placed the three ticks required. The majority of candidates were able to identify at least two correct statements about methods of birth control.

(b) The vast majority of candidates were able to correctly identify the condom or femidom as being effective in preventing the spread of HIV. Clear explanations for this were rare and candidates should be taught that the virus is present in the semen and other body fluids. Many answers repeated the information in the question, or explained how a condom was effective as a contraceptive.

(c) (i) Teachers should ensure that candidates understand the common methods of contraception, as listed in the syllabus. Candidates had difficulty explaining the method and used muddled terminology. The best answers gave an explanation of any method that could be used to calculate or detect when ovulation occurred to assist in the rhythm method.

(ii) The most common correct answer was the low cost of the rhythm method low cost, with religious reasons being cited very rarely.

Question 4

(a) Generally this question was completed well, although some candidates used terms associated with the water cycle or quoted processes at random, such as osmosis or homeostasis. Candidates had the greatest difficulty in identifying process **C** as feeding (or nutrition or ingestion).

(b) A wide range of correct answers were seen. Weaker candidates gave names of minerals or even the names of organs.

(c) More able candidates could state decomposition and name a type of decomposer. The better answers then went on to include the fact that the decomposer would respire the chemicals from the zebra's body and thus release carbon dioxide into the atmosphere. Other candidates, having stated decomposition, mistakenly described the carbon as being absorbed by plants from the soil.

(d) Many candidates gave two good examples, the most common being deforestation and burning fuels. Some candidates appeared to confuse the topic with other environmental issues and a wide range of answers appeared, including release of CFCs, the use of greenhouses and global warming.

Question 5

(a) This question was generally well-answered. Many matched all structures and functions correctly.

(b) Candidates should be taught all of the roles of xylem, not just water transport. A common error was to repeat water, or to give a variation on the stem of the question and state that xylem transported water from the roots to the stem.

(c) This section was fairly well answered, with approximately equal numbers of candidates opting for starch and sucrose. The most frequent incorrect answer was glycogen.

(d) This is an example of a question where candidates who had learnt the definition of transpiration were at a distinct advantage. They could answer quickly and accurately and pass onto the next question. The majority spent time trying to formulate their ideas and frequently gained no credit for

their efforts as the answers given were imprecise. The evaporation of water from the surface of the mesophyll cells is a point that needs reinforcing.

Question 6

Further study of the alimentary canal would benefit the majority of candidates as performance was the lowest on this question.

(a) The position of the pancreas and the stomach were well known, but very few candidates could identify the colon.

(b) Most candidates thought that the sole purpose of the colon was to transfer faeces to the rectum, rather than its role in water reabsorption. More candidates gained credit for the functions of the stomach and pancreas, but it was noticeable that most expressed themselves with less precision on this question than on the rest of the paper.

(c) (i) Candidates must be taught that bile is produced by the liver and is simply stored in the gall bladder. This point was often misunderstood.

(ii) (iii) Some answers contained the correct idea of increasing surface area. In general though, there was much confusion over the action of bile. The most frequent misconception was that bile contained an enzyme that digested fats.

(d) The process of absorption requires more thorough study. Numerous answers described digestion throughout the alimentary canal, or gave information about assimilation. The most commonly awarded mark was for absorption being into the blood or into the villus. There were few references to diffusion, active transport or the increase in surface area.

Question 7

(a) Candidates should be taught to interpret arrows in food webs as identifying the flow of energy, rather than "what eats what" (which was not awarded credit)

(b) Many candidates could interpret the food web and gained full marks. Less able candidates could name a producer and secondary consumer but then gave more names and not numbers for the third and fourth answers. More through reading of the question in this instance would have helped these candidates.

(c) This question part was well answered, with many candidates able to identify an organism that occupied two trophic levels within the food web.

Question 8

(a) (i) Most candidates knew that the answer was meiosis and this was spelt in a wide variety of ways. Candidates must focus on the correct spelling of meiosis, as mis-spellings could be confused with mitosis, which carries a very different meaning.

(ii) The most able candidates used the terms haploid and diploid in their answer. To gain credit, candidates needed to give the relationship, rather than simply state the number of chromosomes in a human gamete and a body cell.

(b) This question part was answered well with many able to use the X and Y symbols and state the genotypes correctly.

(c) (i) This was another example where the learnt definition gave candidates access to the mark. Candidates must be taught to learn and use the definitions presented in the syllabus.

(ii) This was generally answered well and many candidates gained five marks. Sometimes gametes were written with two letters, or genotype and phenotype were muddled, but it was still possible to gain marks for other parts of the genetic diagram.

(d) Most candidates were able to correctly deduce the genotype.

BIOLOGY

Paper 0610/22

Core Theory

Key Messages

It is vital that candidates read each question carefully and carry out the task required. The command words "state", "explain" and "suggest" each require a different type of response. The syllabus contains a glossary of terms used in science papers and this should be referred to when preparing candidates for these assessments. In order to gain full credit, candidates need to understand the subtly of the different commend words in order to tailor their answers appropriately.

General Comments

Compared to previous series more care was taken in reading the question, with fewer candidates looking for a key word in the question and simply writing what they knew about it. Greater care is still needed, with many candidates continuing to give partial answers due to not fully appreciating what the whole question part was asking. The areas in which candidates performed the best this series were in questions where they were asked to handle data. Areas which needed further reinforcement in lessons were interpreting genetic diagrams and sensitivity.

Comments on Specific Questions

Question 1

Nearly all candidates were able to complete the table and most were able to identify at least three molluscs.

Question 2

Most candidates clearly understood fertilisation. However very few candidates gained full marks in part **(a)** because they were unclear about the difference between **asexual** and **sexual**. This error lead into their answers for part **(b)** where they gave detailed answers on sexual reproduction in potatoes.

Question 3

Most candidates correctly identified the temperature on day 7 as 36.8 °C. Some read the value as 36.8 °C which suggests that more practice is required in accurately reading from a graph. Part **a (iii)** was poorly answered due to candidates mis-reading the question. Many gave an answer as to why she took her temperature each day, rather than why she did this at the same time each day. The answer "to make it fair" was correct but insufficient without some explanation of "fair". A range of different hormones were given as answers for part **b (i)**. Careful reading of the question should lead the candidate to look for a hormone that controls both ovulation and puberty, so that the correct hormone from the menstrual cycle could be selected. Most candidates correctly indicated that the hormone is carried by blood.

Question 4

Candidates' answers indicated that they were familiar with tissues as cells arranged in groups. As quite a lot of information was in the stem of the question, extra information was required in the answer. Candidates must be reminded that they will not gain credit for simply repeating information given in the stem. In part **c (i)** most candidates showed a good understanding of diffusion from high to low concentration, but many forgot that there must also be moving particles. In part **c (ii)** candidates showed their understanding of diffusion with correct answers for the substance that diffuses from the lungs to the red blood cell (oxygen). It is important to remember that in the small intestine digestion has occurred, so diffusing substances will be small molecules. Many candidates answered with protein, forgetting that it would have already been broken

down into amino-acids. Although candidates may not have remembered what a bicep was they were given more information in the box, "from muscle cell". Once they have the process (respiration), the diffusing substance (carbon dioxide) is clear.

Question 5

Candidates showed an excellent understanding of food groups. Deficiency diseases were sometimes muddled and the incorrect answer of scurvy was frequently given. Unfortunately many candidates did not refer to Fig. 5.2 when answering part **b (i)** or **b (ii)** and as a result, their answers did not answer the question asked (despite being factually correct). It is important to use the bar chart or other given information, when asked to do so. Parts **c (i)** and **c (ii)** focus on digestion and this seemed less well understood compared to the other question parts.

Question 6

In preparing candidates for this paper, it is essential that they are given practice at interpreting and presenting answers to genetics problems. Many candidates did not score marks due to presenting their answers incorrectly rather than a lack of subject knowledge. In part **(a)** for example the ratio should be stated as 3:1, because the question asks for the ratio of dark-eye to light-eye. Some candidates wrote 1:3 and this would still have been acceptable if they had also gone on to say light-eye to dark-eye. Candidates needed to read the whole first paragraph on the previous page, before attempting part **(b)**, as all the information they needed was there. It was clear which candidates had rushed ahead without fully reading the question. The better candidates gave the classic pattern from their 3:1 ratio. Many candidates were still thinking in terms of breeding when tackling parts **c (i)** and **c(ii)**, and as a result discussed breeding different fish rather than causes of increased mutation.

Question 7

Candidates demonstrated a good understanding of food chains and trophic levels and many were able to calculate energy transferred**.** While most candidates understood the passage of insecticide up the food chain, many were unable to suggest why the concentration of insecticide increased at each trophic level.

Question 8

The carbon cycle was well understood by many candidates and most were able to answer part **(a)**. There was some confusion between photosynthesis with respiration. There was also some misuse of the word respire. Respire is a biological term with a specific meaning, so should not be used to mean "release" or "give out". Part **(b)** was looking for biological processes and candidates needed to look at the whole cycle. Several candidates gave decomposed/decay for **X** as they had not noticed that this process was already present on the left-hand side. Although most candidates understood decomposition, they did not give the detailed answer required for part **c (iii)**. A general answer on the benefit to the environment was insufficient and something more specific than "nutrients" was expected.

Question 9

Most candidates showed that they understood the basics of a reflex, but were often unable to say in what way it was important. While they found comparing hormonal and nervous responses difficult, many were able to compare transmission speed. Part **c (ii)** required an explanation as to why the plant needs to respond in this way. Candidates should link the need for light energy to photosynthesis, so that the plant can do more of this.

BIOLOGY

Paper 0610/23
Core Theory

Key Messages

Candidates should read the questions carefully to ensure that they address the question asked.

General Comments

Most candidates were able to complete all sections.

Comments on Specific Questions

Section A

Question 1

This question was about characteristics of insects and the use of a key to identify insects.

(a) Most candidates were able to state one feature shown in the diagram that is characteristic of insects. Frequent incorrect answers were antennae and jointed legs. These features are not specifically insect characteristics.

(b) The key was used accurately by most candidates to identify the four insects.

Question 2

This question was about the human alimentary canal and how it functions.

(a) The majority of candidates were able to correctly label the five regions of the alimentary canal. Those who did not either muddled the small and large intestines or confused the liver and stomach.

(b) (i) Candidates did not know the two types of muscle used to move food along the alimentary canal and many gave no answer.

(ii) Naming the process that moves food along the alimentary canal proved difficult for most candidates. Many did not attempt an answer. Digestion was a common incorrect response.

(iii) Very few candidates were able to describe how the muscles move food along the alimentary canal. This required the idea of antagonistic action with muscles contracting and then relaxing.

(c) (i) Most candidates were able to write the letter **X** on the graph to show when the tablet was in the stomach.

(ii) Candidates found that it was not so easy to justify their placement of the letter **X**. Answers needed to include the idea that the stomach is acidic.

(iii) Reading the highest pH from the graph was straightforward for most candidates.

(d) For candidates who were not able to identify where most digested food is absorbed, common errors were the stomach and large intestine.

Question 3

This question was about the carbon cycle and global warming.

(a) Completing the word equation for aerobic respiration proved difficult for many candidates. Although many made use of the correct chemicals, they were frequently not placed in the correct places. Energy was often included. Other incorrect responses included nitrogen, plants, animals, inhale, exhale and fossil fuels.

(b) Few candidates were able to name all five processes labelled in the diagram of the carbon cycle. Some candidates left some or all of the boxes blank.

(c) (i) Candidates found difficulty in describing and explaining two reasons for the increase in carbon dioxide in the atmosphere.

(ii) Many candidates had not read the question carefully enough and wrote about personal ways of reducing greenhouse gases, instead of suggesting a step that governments could take to try to reduce the levels.

Question 4

This question was about a woodland food chain.

(a) (i) Many candidates were not clear that the arrows in a food chain represent the direction of energy flow. Many responses were too vague, describing feeding relationships without any consideration of energy. Others referred to energy or energy exchange without any further qualification.

(ii) Most candidates correctly related the size of the arrows to a representation of the quantity of energy. Some incorrectly suggested that the size was to do with the numbers of organisms.

(b) Many candidates were unable to identify the amount of energy passing from the producers to the first consumers. Some incorrectly assumed that all energy from one trophic level passes to the next. Others calculated energy losses.

(c) Nearly all candidates were able to identify the carnivores in this food chain.

(d) Few candidates were able to account for the energy in the robins that was not passed on to the owls.

Question 5

This question was about enzymes and their action.

(a) (i) The syllabus definition of an enzyme was not known by many candidates. Some candidates included descriptions of using enzymes to mix or beak down food. Other candidates provided no response.

(ii) All possible answers were given in response to this question about the composition of enzymes. Carbohydrates was a common incorrect response.

(b) (i) Temperature was the common correct answer with a few candidates recognising pH as another alternative.

(ii) Many responses were too vague to receive credit. Specific information about how a condition affects the activity of an enzyme was required, e.g. as temperature increases, the rate of reaction increases. Some candidates wrote about other conditions than that which they had identified in part **(i)**.

(c) Most candidates correctly calculated the answer. Some wrote out a correct method but then gave an incorrect answer.

(d) (i) Few candidates were able to complete the sentences with the name of the enzyme that breaks down proteins and the name of the product of this breakdown. The suggestion that the enzyme was 'amino acids' was commonly made. All combinations of items selected from the list were seen; some candidates selected answers that were not listed.

(ii) Few candidates recognised the significance of digestion producing smaller molecules that are soluble. Common incorrect answers included 'to make amino acids' and 'so that they can be digested'.

Question 6

This question was about inheritance.

(a) The correct definition of pure-breeding was described by very few candidates. Common incorrect answers included breeding with the same type, breeding naturally and having a natural combination of genes.

(b) (i) Few candidates correctly described an allele. Common incorrect answers identified an allele as a gene, a combination of genes or a chromosome, or referred vaguely to genetics.

(ii) Many candidates correctly identified which allele was recessive and which was dominant. Some incorrectly concluded that particular types of antennae were associated with breeding faster or were connected with food. A number gave no response at all.

(c) (i) Most candidates correctly calculated the number of beetles with short antennae. Some provided no response.

(ii) Calculating the ratio and writing it correctly was more difficult for candidates. A variety of methods for expressing the ratio were accepted. Some candidates reversed the order of the ratio to give incorrect responses, e.g. 1:3 and 1 in 3.

(d) This question required candidates to represent a standard heterozygous cross in a genetic diagram. Incorrect responses included using two letters for each gamete and using letters to represent the offspring phenotypes.

(e) Candidates recognising the offspring ratio of 1:1 were able to deduce the genotype of the parent with long antennae.

Question 7

This question was based in the context of hydroponics – growing plants in a mineral solution without additional water. The questions were about what a plant needs for healthy growth.

(a) Few candidates knew the names and functions of different plant cells and many incorrect responses and blank responses were evident. Common mistakes were to reverse the expected answers.

(b) Many candidates were unaware of the roles of nitrate and magnesium ions in plants. Common incorrect answers included for growth (too vague), to receive sunlight and to get oxygen. Some candidates provided no response.

(c) Few candidates recognised that the question was asking why the mineral solution needed continual replacement, rather than a description of its function.

(d) (i) Candidates found this question difficult and many did not describe the trend shown by both sets of results.

(ii) This question proved challenging to candidates. Few were able to link the effect of supplying air on potassium uptake, as shown in Fig. 7.2, or the effect of potassium uptake on the yield of tomatoes.

(e) This was well answered and many candidates were able to state two factors, other than water and minerals, that plants need to grow. Some candidates restated the factors already given in the question.

Question 8

This question was about growing and breeding different varieties of potatoes.

(a) Many candidates were able to name two features that a potato grower might want to introduce into a new variety of potato. A great variety of valid answers were seen. However, some answers needed further qualification, e.g. size is too vague since it does not imply a direction of change.

(b) (i) Candidates answered this quite well but sometimes muddled D and B.

(ii) Few candidates were able to respond effectively to this question which required reference to sexual reproduction and meiosis.

(c) Similarly, few candidates were able to provide effective answers by recognising the role of mitosis in asexual reproduction.

(d) Most candidates selected the correct answer.

BIOLOGY

Paper 0610/31
Extended Theory

Key messages

- Candidates should always take time to read the questions carefully. All the information and data provided should also be studied carefully.
- Candidates should always give the specified number of responses when this is requested.
- Candidates should avoid repeating the information given in the questions.
- Candidates should be encouraged to use the correct scientific terminology. Vague terms rarely gain credit and hence words such as 'affect' and 'change' should be avoided.
- Examiners accept phonetic spelling where words are recognisable and unambiguous. Phloem in **Question 6(c)(ii)** was often misspelt, but credit can be given if there is no confusion with another term. Candidates should pay careful attention to words that can be confused, for example, glycogen and glucagon, mitosis and meiosis, antibodies and antibiotics.
- Candidates showed understanding of the differences between sexual and asexual reproduction although in **Question 5** some assumed that the nematode reproduces asexually, even though Fig. 5.2 shows the formation and fusion of gametes. In spite of studying self-pollination that leads to self-fertilisation in flowering plants, this knowledge was not always applied to an unfamiliar example.
- Candidates should be encouraged to write their answers to the longer questions in continuous prose. Lists and phrases that do not link together the appropriate scientific concepts are unlikely to gain much credit. Some candidates give their answers in the form of bullet points and the information given is insufficient for credit to be awarded.
- Incorrect answers must be clearly crossed out and the correct answer should be written alongside or just above the first answer. Where an answer is a single letter or number, it is particularly important that candidates do not write on top of the original answer
- Answers that are continued in blank spaces or on additional paper must be clearly numbered. At the end of the answer space provided, candidates should state where to find the rest of the answer. However, if only one short phrase that is no more than one line in length is given then it can be included immediately below the last answer line.
- Candidates should avoid writing answers initially in pencil and then overwriting in pen. Any pencil markings that were missed during this process are unlikely to be sufficiently clear to gain credit. Candidates should also not use thick felt tip pens as the ink can make it difficult to read answers written on the reverse of the page.
- Candidates should attempt every question and take note of the mark allocation for each question part as a guide to how much detail is required.

General Comments

This was an accessible paper allowing candidates across the full range of ability to demonstrate what they knew. There were some more challenging and stretching questions for the most able who often responded with excellent, well written and coherent responses to the questions that required longer answers.

Most candidates attempted all the questions and almost all completed the paper within the time available. Some handwriting, however, was difficult to read.

Questions often require candidates to use the data provided to support a description of a trend or pattern from a graph or a table. In **Question 2**, candidates were expected to study a table of information about three types of milk. Many candidates did not make best use of the data available.

The definitions for the term *enzyme* in **Question 2(d)** were generally much better than those given for *respiration* in **Question 4(a)**. The definition of the latter must take into account that it encompasses both aerobic and anaerobic respiration.

Comments on specific questions

Question 1

Many candidates scored well on this question, giving good answers about eutrophication in part **(b)**.

(a) Most candidates were able to score highly on this question. The most common correct answer was fertilisers for phosphate, with many correctly giving factories or industry for sulfur dioxide. Very few candidates referred to natural sources of the pollutants, such as volcanoes for sulfur dioxide and background radiation for ionising radiation. A few incorrect answers gave herbicides as sources of phosphate and 'damages the ozone layer' for the effect of ionising radiation on the environment.

(b) Overall, candidates scored well on this question, with many giving more than five of the expected answers. Despite some weaker candidates missing the point and describing bioaccumulation or climate change, very few candidates scored no credit at all. Common errors involved confusion between bacteria that were thought to be responsible for the algal bloom and the idea that a covering of algae reduced the absorption of oxygen from the air at the surface of the lake. Some candidates described how aquatic organisms would die, but either this was not explained or it was attributed to the high concentration of carbon dioxide.

(c) Most candidates identified one or two of the expected answers. Many candidates lost credit because their answers were too vague. For example, some stated that 'less fuel' could be used and 'less sulfur dioxide' should be produced. They also suggested impractical solutions, such as 'close down factories' and 'don't use cars', or referred to incorrect biological solutions, such as 'plant more trees' or 'use less pesticides or fertilisers' or 'produce less methane'. The last answer illustrates the problems that candidates can have with correctly linking the pollutant, its source and its environmental effects.

Question 2

This question covered several topics from ***Sections II*** and ***III*** of the syllabus. Some candidates forgot that the question was centred on cattle and wrote about humans, particularly in part **(b)**.

(a) There were many excellent answers to this question. Many candidates were awarded full credit for giving a well annotated genetic diagram, usually incorporating a Punnett square. Less successful answers omitted to identify that males are XY and females are XX, or stated that males are XX and females are XY. Some stated that males were YY and females XY and others used different letters and then confused sex determination with monohybrid crosses using terms such as *dominant* and *recessive* in their answers. Although implied by the Punnett square or criss-cross lines in the diagram, very few candidates stated in words that fusion of gametes is a random process. Candidates should note that genetic diagrams are much clearer and easy to follow if they include a Punnett square. However, Punnett squares should be prefaced by the phenotype and genotype of the organisms being crossed and followed by a list of the genotypes and phenotypes expected to show how a ratio is derived.

(b) A significant number of candidates misread or did not appreciate that the question was referring to AI in cattle and subsequently went on to describe AI in humans or IVF in humans or cattle. Candidates who gained some credit in this question by identifying that the sperm should be placed in the oviduct or uterus, rather than the vagina or cervix, often did not explain that AI should happen at around the time of ovulation. The more able candidates appreciated and could explain the need to isolate the sperm carrying the X chromosome.

(c) A significant number of candidates simply quoted a list of nutrients using general terms such as 'more or less than' or gave a list of figures for each nutrient. When figures were quoted, they were usually correct. A few candidates omitted or made errors with units.

Candidates who explained clearly the advantages of formula milk over cow's milk produced good answers for iron and vitamin D. They either gave their roles in the body or stated that they prevent anaemia and rickets respectively. Fewer candidates were confident in their description of vitamin A which was often mentioned, sometimes as part of a list but less well described, with few candidates describing its role in the immune system. A small number of candidates commented on the idea that formula milk was closer in composition to human milk than cow's milk, or identified nutrients

that were similar in composition. Relatively few remarked on the problems that infants might encounter with attempting to digest a high protein feed.

(d) Almost all candidates gave clear, confident definitions and many were awarded full credit for giving one carefully constructed sentence which included the term *biological catalyst*. Enzymes as proteins and their role in a reaction were also well known by the majority of candidates. Some very well prepared candidates made references to the active site of an enzyme and to the role of enzymes in lowering activation energy.

(e) A significant number of candidates clearly and logically explained the results, appreciating that test-tubes and Petri dishes 1 and 3 related to the effect of pH on lysozyme, test-tubes and Petri dishes 1 and 4 to the specificity of lysozyme, and test-tubes and Petri dishes 1 and 2 to the effect of temperature on the activity of lysozyme. Furthermore, they linked their explanations to the effect on the growth of bacteria in each test-tube. Candidates who attempted to explain the results in terms of the bacteria rather than the lysozyme gained some credit. For example, some gave answers such as 'bacteria prefer an acid pH to grow'.

Of the three sections the most problematic appeared to be the explanation of enzyme specificity. The term *denatured* was well known and used correctly in the first and third parts of the question. There were frequent descriptions of results rather than explanations, and a number of candidates only gained credit for a description of 'no growth of bacteria in test-tube 1' as they showed no understanding of the investigation. Very few candidates recognised the significance of test-tube 2 as a control to show that lysozyme is responsible for the lack of growth in test-tube 1.

(f) Many candidates identified the general idea that antibodies gave protection from pathogens or from disease. There were relatively few clear explanations of passive immunity or detailed knowledge of the functions of antibodies. Little reference was made to the diseases, either generally or by name, suffered by the mother and the subsequent benefit of her antibodies to the child. There was an element of confusion of the function of antibodies in relation to phagocytosis, where antibodies were often stated to 'engulf bacteria'.

Question 3

(a) (i) Many candidates stated here that glucose concentration in the blood increases because a meal had been eaten or absorbed recently. They often stated that it would be a meal high in sugar or in carbohydrate. Other expected answers, such as references to adrenaline, glucagon, dehydration or loss of water were also seen. As the breakdown of glycogen was included in Fig. 3.1, this was not enough to be awarded any credit.

(ii) Again, reference to storage of glycogen was not sufficient. Candidates who stated that the person would be hungry or were fasting or suffering from starvation gained credit. Writing about not eating sugar, starch or carbohydrate for a while was not credited as this suggests that other foods were still being eaten with no effect on the glucose levels.

(iii) A frequent incorrect answer was the pancreas. Others included adipose tissue, the gall bladder, stomach and 'under the skin'.

(b) A frequent error was a statement that the brain, or part of it such as the hypothalamus, monitors the concentration, rather than the pancreas. Another was that insulin directly carries out the conversion of glucose to glycogen. Very few candidates mentioned the role of enzymes in that conversion or the ideas of homeostasis or negative feedback. Good answers included these concepts and some even referred to beta cells in the islets of Langerhans, which was more detail than expected at this level. Some candidates unnecessarily explained how a decrease in blood glucose concentration is controlled.

(c) This part was generally answered well. Credit was lost for stating that the water flow was reversed into the red blood cells with consequent bursting. Confusion arose between the concentration of solute, water concentration and water potential. Concentration is fine for solute diffusion, but osmosis should be described in terms of water potential not 'water concentration'. Some candidates contradicted themselves because they included plasmolysis in an otherwise correct description of red blood cell shrinkage.

Question 4

Definitions of respiration in part **(a)** rarely showed any understanding of the two types of respiration. Very few reflected the definition given in the syllabus. Answers to questions on respiration and exercise varied, although few explained that at the beginning of exercise there is an increase in muscle contraction leading to an increase in the release of energy from respiration.

(a) Many candidates did not give the expected definition of *respiration* giving instead many vague or inaccurate answers. No credit was awarded for giving an equation as that was not required by the question. Many answers included the idea that energy is 'produced' during respiration; this idea was not credited. Most candidates correctly included 'release of energy', but often failed to link this to respiration as a series of reactions, or even as 'a reaction' that takes place inside cells. Although many referred to the breakdown of a named nutrient this was not enough to gain them full credit. Some candidates confused respiration with gas exchange.

(b) Many candidates scored most of the available credit for correctly stating that the biceps contracts and the triceps relaxes. Many interesting spellings of the muscle names were seen, but credit was given so long as they were recognisable. It was rare to find references to the biceps pulling on a tendon that is connected to the radius. More able candidates gained credit for correct references to flexion. Many wrote about the hand 'bending' closer to the chest as a result of contraction of the biceps, which is not the action of this muscle.

(c) (i) Few candidates gave answers thorough enough to gain full credit. The link between increased muscle contraction and the need for more oxygen was not always logically explained. Although some did mention aerobic respiration, most answers just stated that energy and respiration 'had to carry on'. A significant minority of candidates inappropriately discussed anaerobic respiration in this question, often in more detail than they subsequently described in **(c)(iii)**. There were many candidates who indicated that oxygen and energy were needed for exercise, but no indication that more of this was needed than would otherwise be the case, and hence little or no credit could be awarded.

(ii) This should have been quite straightforward but was often poorly answered. Many candidates extended the line on Fig. 4.3 before decreasing it. This question was omitted by a significant minority of candidates, perhaps because they did not read carefully enough and so did not realise that they needed to complete the graph.

(iii) A large number of candidates gained full credit. Some very good, detailed answers were seen. However, many candidates did not realise that this question was about oxygen debt and the breakdown of lactic acid, and instead wrote vague answers about it taking time for the breathing rate and/or the heart rate to slow down. Some candidates made incorrect references to 'anaerobic breathing'. Some candidates provided a description of anaerobic respiration and lactic acid production in part **(c)(i)**, but then gave only a brief response here.

Question 5

Many candidates struggled with this question. The unfamiliarity of a question based around nematodes, combined with the fact that several different syllabus sections were tested in the same question, increased the difficulty for all but the most able candidates.

(a) (i) Most candidates were able to find the genus of the nematode from the information given, and most took great care to copy this exactly. Frequent incorrect answers were 'elegans' and the full binomial. 'Annelid' was a common incorrect answer.

(ii) There were many good answers to this question and the majority of candidates were able to give at least one correct structural feature. Candidates should take care, when they are asked for two answers and given two spaces, to write no more than one answer in each space. Common incorrect responses included 'segmented' and 'slimy'. In general, absence of a feature, such as absence of legs, is not a good choice when stating structural features. Most candidates gained credit for 'unsegmented', expressed in a variety of ways.

(b) This was a relatively low-scoring question. Nevertheless, many answers gained some credit for the idea that nematodes prevent the accumulation of waste material. Others correctly stated the idea that they help to recycle nutrients, although very often attempts at detailed descriptions of the recycling of specific nutrients were incorrect. An example is carbon dioxide, which would have been an obvious choice given the ideas in **Question 4**. Credit was available for stating that nematodes release carbon as carbon dioxide which is then available for photosynthesis. A few gave relevant answers referring to energy flow, but references to 'energy cycling' were not accepted. Most candidates, however, made only one correct point, reiterating one idea rather than moving on to something new. Very few candidates gained full credit for this question.

(c) Some excellent answers were seen, but only the very best were able to gain credit for all three sections. Few applied their knowledge of self-fertilisation in flowering plants from ***Section III*** of the syllabus to the information provided in Fig. 5.2.

(i) The majority of candidates incorrectly stated that *Caenorhabditis elegans* reproduces asexually apparently forgetting that reproduction involving gametes and fertilisation is sexual, even if there is only one parent. However, many did state that the reproduction of *C. elegans* involves male and female gametes from the same individual, and that this would mean that all of the genes (or alleles or DNA) in the offspring came from a single parent. A few pointed out that meiosis, used in the production of the gametes, would produce a small amount of variation between these gametes, and some also mentioned that mutation could produce variation. Several candidates suggested that, as nematodes have so few features anyway, there is not much scope for variation, but this was not credited. Another incorrect answer was that the small number of chromosomes of *C. elegans* would mean that there were not enough different genes to provide any variation. There are in fact over 20 000 different genes that code for proteins.

(ii) The majority of candidates used the information to calculate the haploid number as 6. Many, however, doubled 12 to obtain an incorrect answer of 24, and numerous answers gave 23, presumably remembering the haploid number of humans.

(iii) There were some excellent answers to this question, but these were in the minority. For the first section, good answers clearly stated that at **P** gametes are being formed and that this involves halving the chromosome number to produce haploid cells. Some went on to explain why this was necessary in terms of maintaining the correct diploid number in the zygote. However, although many answers used at least one of the correct terms, these were often not in a sentence that made any sense. In particular, it was often not clear that the process involved the *formation* of gametes and many candidates implied that the gametes were dividing by meiosis, rather than being formed by it. Many stated that 'meiosis occurs in fertilisation'. Some simply quoted the definition of meiosis that they had learnt, without attempting to apply it to this specific context. In general, this part of the syllabus appeared to be poorly understood by most candidates. For **P**, common incorrect responses were 'meiosis is due to fertilisation'; 'it is fusion of egg and sperm to produce a zygote'.

The second section, about mitosis, was answered a little better than the meiosis section. Many candidates stated that growth was now taking place, and that two identical copies of the cell were required each time mitosis occurred. Some also stated that this division involved a diploid cell dividing to form more diploid cells. Again, there were numerous answers that simply quoted the definition of mitosis, without relating it to the context as required. For **Q**, common incorrect responses were 'asexual reproduction', 'cell division' and 'the zygote can now perform cell division on its own'. Candidates tended to write about mitosis producing 'duplicate cells', rather than producing *identical* cells. A better response would have been to say that the cells are *genetically identical*.

(d) This was generally answered entirely correctly, with most candidates able to state that DNA is found in the chromosomes in the nucleus. Not all candidates appeared to notice the mark allocation and gave only one answer, which was usually the nucleus.

Question 6

This question was straightforward for many candidates. Credit was often lost because answers included contradictory material, such as stating that transport of sugars occurs in the 'xylem and phloem'.

(a) Most gave the correct answer given to three decimal places, although the Examiners accepted answers that were rounded up to whole numbers or to one or two decimal places. The most common error was to omit the units.

(b) Very few candidates gained full credit for this question. Many called the bacteria 'nitrifying' and the body of the answer was related to nitrates and/or nitrites. Others stated that the bacteria protect the plant from infection by pathogens, such as fungi and bacteria. Even if the correct role was given for these bacteria and nitrogen gas was included, the product was rarely correct. Only a very few stated that the ammonia or ammonium ions produced are converted to amino acids.

(c) (i) Most candidates gained full credit here for stating that carbohydrate is produced by photosynthesis from carbon dioxide and water or using light as a source of energy.

(ii) Many gained full credit for referring to the transport or translocation of sucrose in the phloem from the leaves. Some referred incorrectly to the xylem as the transport tissue and others to 'xylem and phloem' which did not gain credit. The spelling of phloem was generally good, although misspellings such as the most common, 'pholem', were credited. Candidates who stated that sucrose diffuses into the nodule generally did so in addition to the other expected points.

(d) Many scored full credit for a statement about active transport. Again those who gave further detail by referring to carrier proteins had already given the other expected answers. The most common errors were to describe adaptations of root hairs and to explain the uptake in terms of diffusion, or even osmosis, rather than active transport.

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Key Messages

- Candidates need to ensure that questions are read carefully, following all the instructions given to them. They should also read their answers to avoid careless errors. Specific examples seen included not rounding an answer to the nearest whole number, and writing 'lymph', instead of 'lymph vessel'.
- Candidates should give only the specific number of responses requested in a list. This includes questions where only one response is requested.
- Candidates need to be encouraged to use the correct scientific terminology. Vague terms rarely gain credit and hence words such as 'affect' and 'change' should be avoided. Although phonetic spelling is generally accepted where it is unambiguous, careful attention should be paid to words that could be confused, for example 'fibrin' and 'fibre', 'glycogen' and 'glucagon', 'mitosis' and 'meiosis'.
- Candidates need to be able to explain biological principals correctly. The use of scientific terminology in the wrong context will not gain credit. On occasion, a limited command of English impedes the ability of a candidate to explain concepts adequately, but most often candidates do not pay enough attention to their expression of the biological principal. For example, energy is *released* from mitochondria, it is not produced (see **Question 2 (a)(iii)**); water loss from a leaf creates *less* pressure not more pressure (see **Question 3**).
- Candidates should be encouraged to write in continuous prose for longer answers. Lists and phrases that show no demonstration to link the ideas to the appropriate scientific concept are unlikely to gain credit.
- Answers that are continued in blank spaces or on additional paper must be clearly numbered. Candidates should make reference to the continued answer in the answer space provided for that question. However, if only one short phrase (no more than a line) is required to complete an answer, this can be included immediately below the last answer line.
- Candidates should avoid writing initial answers in pencil and then overwriting in pen. Any pencil markings that were missed during this process are unlikely to be sufficiently clear to gain credit. Candidates should also not use thick felt tip pens. The ink can run through the paper to affect the clarity of the answer on the reverse. Incorrect answers must be clearly crossed out and the correct answer should be written alongside or just above the first answer.
- Candidates should attempt every question and appreciate that the mark allocation for a part question is an indication of how much detail is required.

General comments

The majority of candidates were well prepared and showed a detailed knowledge of the theory examined, although a few able candidates were unable to answer some of the straightforward theory questions, suggesting that their knowledge and understanding of sections of syllabus were not secure. Water uptake in plants and homeostasis of blood glucose were two concepts that were poorly explained. Very few questions were omitted and there was no evidence that shortage of time was an issue. A small minority of candidates who had a limited command of English, were unable to access all the available credit, often due to an inability to express themselves clearly in their answers to questions that required reasoned explanations or lengthy descriptions.

Comments on specific questions

Question 1

This question explored the growth of the fungus *Penicillium* in a fermenter, a topic that was understood by the majority of candidates.

(a) Most candidates were able to correctly name the stages of the growth curve, although lag and log were regularly confused. A minority of candidates did not answer this question.

(b) Most candidates were able to give at least one factor that should be kept constant, but only the more able candidates named two correctly. Common misconceptions were giving light intensity and humidity which are applicable to photosynthesis experiments. Where only one correct answer was given, it was usually temperature.

(c) Although most candidates obtained full credit for this question, very few knew that this mould fungus is made of hyphae rather than individual cells. Several identified that if the fungus were comprised of cells that they may be of different sizes and therefore a source of inaccuracy.

Question 2

The well-prepared candidates were able to name the structures and hormones correctly, but many found it more challenging to give sufficient detail in the questions that required explanations.

(a) (i) Many candidates were able to name the items in Fig. 2.1. In naming the oviduct, the most common incorrect answers were 'ovary' and 'uterus'. 'Fertilised egg' was the most common error in naming the zygote.

(ii) Slightly fewer candidates gained credit for this question. Many appeared to have misread this question, citing a hormone for the first part, as required, but actually naming process B rather than the hormone as required for this process. Candidates occasionally confused LH with FSH and vice versa. Candidates occasionally gave muddled letter combinations, such as LSH. A significant number of candidates named the hormones as oestrogen and progesterone.

(iii) The most commonly explained feature of a sperm cell was its tail adapted for swimming. The purpose of mitochondria was also regularly mentioned, but 'production' of energy by mitochondria was a common error. The roles of the sperm nucleus were usually too vague. The Examiners rarely saw answers that stated that a haploid sperm nucleus fused with the egg; equally rare were references to the transfer of genetic information by the sperm nucleus. Very few candidates correctly described the function of the acrosome, with many of these candidates making reference to the destruction of the *cell membrane* of the ovum. Additionally, many candidates stated incorrectly that sperm contain nutrients, or misread the question and discussed functions of seminal fluid.

(b) Most candidates found this question challenging. Mentioning variation was the most common credit gained. Although adaptations were often mentioned, it was less often that this was in the context of the advantages of adaptations to new or changed environments. When meiosis was mentioned there was often no link to it being a cause of variation.

Question 3

This question explored the movement of water through a plant, a topic that was familiar to almost all candidates, although often the concepts were poorly explained or misunderstood. It was necessary to follow carefully the pathway of the water molecules to avoid any confusion with **(a)**, **(b)** and **(c)**. The question concluded with sewage treatment and the environmental damage caused by herbicides.

(a) Some very detailed, confident answers were seen to this question. However, many candidates did not read the question carefully and started their explanation in the roots, rather than in a leaf cell. A common omission was the mention of water *vapour*, with many candidates making no mention of the change in state. Many candidates only obtained partial credit here for the word *transpiration* in their answers. Candidates should try to follow complex processes in a logical series of events and describe them in a sequence.

(b) Although most candidates were familiar with the terminology used to describe water movement through the stem, many found it difficult to explain these concepts correctly. It is a specific requirement in the supplement syllabus, but not in the core, that candidates should have an understanding of water uptake in plants in terms of water potential. Many candidates seemed unfamiliar with the term *water potential* and instead used 'water concentration' to describe the negative pressure created in the upper part of a plant. The words cohesion and adhesion were often used incorrectly or used without any explanation and so did not gain credit. In a few cases, cohesion was given as the force which drives transpiration pull. A large number mentioned transpiration, but not transpiration *pull*.

(c) Of the three questions on plant water movement, this question was answered most confidently. Quite a few candidates did not refer to partially permeable membranes even though they clearly knew about osmosis. The use of the term *water concentration* instead of water potential was commonly seen. A number of candidates also included information on the adaptations of root hair cells for increased surface area for water absorption even though this was not asked.

(d) A wide range of processes in sewage treatment were seen. The most common were filtration and chlorination, followed by sedimentation to settle particles. A considerable number of candidates mentioned adding fluoride to water. Although it is common in some parts of the world to add fluoride to drinking water, this is not part of the process in the treatment of sewage.

(e) Although some candidates gave thorough, well-considered explanations for the environmental damage caused by herbicides, all too often the automatic answers for pollution were seen, with candidates describing eutrophication, acid rain and global warming. Herbicides were often confused with fertilisers or pesticides. Few candidates obtained credit either for the selection of herbicide resistance or for weeds becoming more difficult to control.

Question 4

Blood was the common thread through this question. Although most candidates were well versed in functions and components of the blood, a number of common misconceptions were also highlighted.

(a) (i) Most candidates knew urea to be an excretory product, with a small minority offering hydrogencarbonate ions. Most candidates only gave one response, as required by the question. Those who gave more than one response usually gained no credit at all.

(ii) This question was also generally well answered. Adrenaline was the most common incorrect answer.

(b) (i) Many vague answers were seen to this question. The reference to exercise was very frequently seen without further qualification.

(ii) This question was generally well answered although many candidates confused fibrinogen with fibre and discussed bowel movements as the function of fibrinogen.

(iii) Although most candidates were familiar with the effects of adrenaline, the weaker candidates gave insufficient scientific detail in their answers. They wrote 'increase in glucose' without qualifying it with 'in the blood', or they wrote 'sweating' without suggesting an *increase* in sweating. The most common answers were dilation of the pupils and increases in heart rate, breathing rate and blood pressure.

(c) This question highlighted misconceptions regarding the role of the hormones insulin and glucagon. Many confused the roles of these hormones with the enzymes that convert glucose to glycogen. Insulin does not 'convert glucose to glycogen'; that function is carried out by enzymes inside liver cells and muscle cells. A number of candidates also confused the terms glycogen and glucagon or thought that insulin and glucagon were produced in the liver. Nevertheless, thorough descriptions were seen regularly. Misspellings of glycogen and glucagon were relatively common. Since these usually caused too much ambiguity, no credit was awarded. Only the most able candidates mentioned homeostasis.

(d) (i) The majority of candidates were able to perform this calculation, although some did not read the question carefully, and did not round their answers to the nearest whole number. A significant minority used 3500 as the denominator instead of 1300.

(ii) There were some very thorough descriptions of the role of phagocytes against disease, although some candidates confused the roles of phagocytes and lymphocytes. The mark point referring to the ability of the phagocyte to present the antigen to the lymphocyte was very rarely awarded.

(iii) Tissue rejection was also a familiar concept to most candidates; however, many did not give enough detail regarding naming the types of white blood cells involved. Candidates should distinguish between the functions of lymphocytes and phagocytes. Some incorrectly discussed protection against bacteria instead of tissue rejection.

Question 5

(a) Most candidates realised that food moves along the small intestine by peristalsis, but fewer were able to describe this process in sufficient detail to gain full credit. There were many answers that commented on muscles contracting and relaxing, but without clarity. Numerous candidates referred incorrectly to villi or microvilli acting as cilia and 'wafting' food along. Only the best prepared candidates made reference to the contraction of longitudinal and circular muscles.

(b) (i) Many candidates were able to name the structures of a villus. Blood vessels were commonly mentioned without specifying capillaries. However, this was the structure most often correctly identified. The epithelium was often named as epidermis or villi. Quite often the lymph vessel was referred to as lymph.

(ii) Most candidates knew that the hepatic portal vein transports blood away from the small intestine.

(iii) The need for a large surface area was the most common explanation for the presence of microvilli on epithelial cells of a villus. Candidates sometimes did not expand on this answer by explaining that a large surface area leads to *increased* absorption.

(iv) Only the more able candidates were able to apply their knowledge about the mucus that lines the trachea to suggest what the villus would need to be protected against. Rarely did candidates refer to enzymes or to stomach acid. The most frequent answer seen was protection against bacteria. Many candidates gave answers more appropriate to the gas exchange system, such as stating that mucus protects against 'tobacco smoke' or simply 'dust'.

Question 6

(a) Almost all candidates were able to name visible features of myriapods. The most common incorrect terms were 'segmented legs' for jointed legs and 'tentacles' or 'whiskers' for antennae.

(b) The ability to identify and appropriately describe distinguishing features of the four myriapods was more challenging, although some excellent answers were given. Many candidates failed to give clear comparative features, such as length of leg, and many simply restated their answers for part **(a)** or created features such as eyes or feet. Many candidates were unable to distinguish between antennae and tail pieces.

(c) (i) Almost all candidates knew that the nucleus contains most of the DNA in a cell. The most common incorrect answer was chromosome. Several peculiar spellings of nucleus were seen.

(ii) Although barcoding was a new concept to most candidates, many, usually the stronger candidates, were able to use the information provided to give creditworthy suggestions as to its use in conservation. Weaker candidates repeated the information in the passage. Many candidates did not give concise answers. The use of DNA for cloning or some form of genetic manipulation to prevent extinction was a common answer.

(iii) The well-prepared candidates gave detailed functions of the DNA in cells. Weaker candidates often gave a description of DNA or stated that DNA 'controls the cell', a response that is not creditworthy at this level. Mentioning that the DNA is replicated so that information can be passed to new cells was extremely rare. Surprisingly, few candidates understood the central dogma of Biology that DNA codes for proteins.

(d) (i) Most candidates were able to construct the food web correctly. The most common error was to point arrows in the wrong direction or not to place any arrow heads on the lines. Sometimes 'bacteria' were omitted from the food chain. A few candidates drew separate food chains instead of a web. A number of candidates also included pictures of each organism even though this is not required when drawing a food web.

(ii) Many candidates were able to describe respiration or decomposition as the role of soil organisms in the carbon cycle. A common error was to discuss the release of carbon rather than carbon dioxide or to state that fossil fuels were burnt, releasing carbon dioxide.

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Key Messages

- Candidates need to read questions carefully and follow all the instructions given to them. Answers should also be read and checked to avoid careless errors. Examples include not including units in a numerical answer or a data quote.
- Candidates should give only the specific number of responses requested in a list. This includes questions where only one response is requested.
- Candidates need to be encouraged to use the correct scientific terminology. Vague terms rarely gain credit and hence words such as 'affect' and 'change' should be avoided. Although phonetic spelling is generally accepted where it is unambiguous, careful attention should be paid to words that could be confused, for example mitosis and meiosis.
- Candidates need to be able to explain biological principles correctly. The use of scientific terminology in the wrong context will not gain credit. On occasion, a limited command of English impedes the ability of a candidate to explain concepts adequately, but most often candidates do not pay enough attention to their expression of the biological principle. For example in **Question 3(e)** many candidates wrote that energy is produced, rather than energy is *released.*
- Candidates should be encouraged to write in continuous prose for longer answers. Lists and phrases that show no demonstration to link the ideas to the appropriate scientific concept will not gain credit.
- Answers that are continued in blank spaces or on additional paper must be clearly numbered. Additionally, candidates need to make reference to the continued answer in the answer space provided for that question. However, if only one short phrase (no more than a line) is required to complete an answer, this can be included immediately below the last answer line.
- Candidates should avoid writing initial answers in pencil and then overwriting in pen. Any pencil markings that were missed during this process are unlikely to be sufficiently clear to gain credit and may obscure the inked answer. Candidates should also not use thick felt tip pens. The ink run through can affect the clarity of the answer overleaf. Incorrect answers must be clearly crossed out and the correct answer should be written alongside or just above the first answer.
- Candidates should attempt every question and appreciate that the number of marks available for a part is also the minimum number of points that should be written.

General comments

Particularly challenging on this paper were the structure and function of the kidney in **Question 5** and natural selection in **Question 4(d)**.

Those candidates who did not read the instructions before planning their answers tended to lose credit through misinterpretation. Some candidates found it difficult to interpret the information provided and use it to construct their answers. However, well-prepared candidates with a detailed knowledge of the topics were able to convey their understanding.

Comments on specific questions

Question 1

(a) Many weaker candidates seemed unfamiliar with the difference between 'genes' and 'alleles', describing the organisms as having *similar* genes, whereas what is key to the DNA of a species is that it will contain the *same* genes, although possibly similar alleles. References to 'similar genetic information' were too vague.

(b) (i) Mitosis and spore production were the most commonly credited points for this question on fungal reproduction. Although this topic forms part of the Core syllabus, very few candidates were sufficiently well-prepared to elaborate on the sequence of events such as the formation of vertical hyphae, the production of spores within a sporangium and spore dispersal There were also incorrect references to pollen grains and to seeds.

(ii) The most commonly seen correct answers to this question on the advantages of asexual reproduction included the fact that it is a fast method of reproduction as only one individual is involved so that there is no search for a partner and no production of gametes. Those candidates who did not restrict their thinking only to reproduction of fungi, where spores are often widely dispersed, extended their answers to include some of the more commonly stated advantages of asexual reproduction.

Question 2

(a) A wide variety of gases that can cause acid rain were suggested. Carbon dioxide was the most popular correct answer followed by various oxides of nitrogen including nitrogen oxide. Methane was a common incorrect response with some weaker candidates apparently overlooking the word 'other' in the question and restating 'sulfur dioxide' given in the prompt material.

(b) Most candidates obtained credit for mentioning damage to plants, but some seemed unaware that animal casualties due to acid rain live in water. General references to animals were too vague to gain credit.

(c) Commonly seen ideas for reducing atmospheric sulfur dioxide pollution included a wide range of alternative or renewable sources of energy, such as biomass, wind and geothermal energy as well as the latest gas-to-liquid fuel technology which produces very pure petrol or diesel. Some suggestions for reducing atmospheric sulfur dioxide pollution were too extreme and impractical, for example, 'closing factories' and 'stop burning fossil fuels'. 'Filtering' in a variety of contexts also did not gain credit.

(d) (i) Many candidates find questions that require data analysis challenging. This question involved careful study of the data in Fig. 2.1 which showed the changes in atmospheric sulfur dioxide concentrations measured in $\mu g\,m^{-3}$ and the percentage content of sulfur in plant tissues. Candidates sometimes confused the two scales on the graph or omitted units from their data quotes so did not gain full credit for taking information from the graph. Readings for changes in the concentration of sulfur dioxide in the atmosphere should have been taken from the left hand *y*-axis and readings for the changes in sulfur content of plant tissues from the right hand *y*-axis. Often the less able candidates did not do this. Stronger candidates referred to the significant changes that occurred in 1997 reference to this particular year. More confident candidates were able to identify the most obvious points, while weaker candidates referred instead to less significant points from the graph and often did not make clear what they were describing.

(ii) This question asked candidates to explain why the data for sulfur content was calculated as a percentage of the dry mass of the plant tissue. Only the well-prepared candidates knew that the water content of plant tissues constantly changes with variations in water uptake and water loss by transpiration. Some candidates stated that calculating the content as a percentage means that valid, or easy, comparisons can be made between samples. However, many seemed unfamiliar with this scientific concept.

Question 3

(a) Candidates were expected to make clear the two aspects of the sensitivity definition given in the syllabus. Both aspects, the detection of a change in the environment and the response or reaction to a stimulus or stimuli that happens as a result were seen.

(b) Most candidates gained credit for stating that a voluntary response involves thought, decision-making, choice or self-control. Many then added that involuntary responses do not involve these actions. Only partial credit could be awarded unless another aspect was given. Some candidates referred to the speed of one or other or both types of response and reflexes, occasionally with examples, were often mentioned as examples of involuntary responses. Many candidates did not give two *different* aspects in order to gain full credit. Many candidates stated that voluntary responses are 'controlled' while involuntary responses are not. This is not correct as both

responses are under the control of the nervous system. Candidates who give this sort of answer need to be more precise.

(c) Most candidates named the sensory neurone as the type of neurone responsible for transmitting impulses from a receptor. The alternative term afferent neurone was also seen. Motor neurone was a common incorrect answer.

(d) Candidates often interpreted the information about two swimming teams in Table 3.1 correctly and gained credit for stating that the first swimmer is each team responds the slowest. Some candidates compared the first swimmers in each team which was not asked by the question; some went further to compare swimmer 2 in team A with swimmer 2 in team B and so on. Weaker candidates were not always able to select suitable data quotes; they often gave the times from the table but without the units. They rarely looked at the times for swimmers 2, 3 and 4 and stated that they were all very similar, or calculated a mean. Candidates can always carry out calculations to illustrate answers to questions like this one. It was rare to find a candidate mention that swimmer 3 of team 2 has a very different response time compared to the others.

(e) Most candidates were able to give an effect or two of adrenaline on the human body; many candidates stated that the effect of this hormone would be to improve performance or speed. A common error was to state that energy is produced rather than released in the context of respiration.

Question 4

Candidates found the explanation of why flowering time in this species is an example of continuous variation in part **(c)(ii)** most challenging.

(a) (i) Most candidates were able to state that the products of meiosis are pollen grains. A common error was to name them as 'gametes' without qualifying *male* gametes, suggesting that these candidates had not read the question carefully.

(ii) Many candidates were able to give two features of meiosis in the context of sexual reproduction. The most common correct answers were to refer to the halving of chromosome number and generating variation. It was less common to see candidates elaborate further by explaining that meiosis ensures that the chromosome number remains constant from one generation to the next. Meiosis was frequently confused with mitosis in the answers and references to the number of chromosomes in humans (23 and 46) were given even though the question was not specifically about humans.

(b) (i) Only candidates who gave two aspects of this definition of cross-pollination were able to gain full credit. Candidates had to state that pollen grains are transferred from anther to stigma and that they are transferred between flowers on different plants of the same species. A common omission was to state that pollen is transferred to different flowers without making it clear that the flowers must be on different plants. A common misconception was that cross-pollination involves the pollen going to plants of a different species.

(ii) The most common correct answer to this question was the presence of large petals. Reference to the guidelines or patterns on the petals was seen less often. Because the question stated that the feature had to be visible in the photograph which was printed in black and white, references to colour were not accepted.

(c) (i) Candidates were generally successful in suggesting an environmental reason why lilies that grow at lower altitude flower earlier than those that grow at higher altitude in the Himalayas. This attracted a wide range of acceptable answers, such as temperature, light and pressure.

(ii) This question was rarely answered correctly, although continuous variation and discontinuous variation are key concepts in understanding genetics. Candidates found it difficult to apply what they knew about continuous variation, perhaps from investigating and displaying human heights, to times when plants flower. However, candidates did gain credit by just explaining the nature of continuous variation.

(d) Natural selection is a topic that many weaker candidates find challenging and although some were able to state learnt phrases such as the presence of variation and mutations, only the more able

candidates gave a full explanation in context. Only the most able candidates used clues from earlier in the question and suggested that this might happen if there is no exchange of pollen between plants at high and low altitude.

Question 5

(a) Many candidates were able to identify the parts of the kidney although it was common to see at least one error. The most common correct answer was the ureter (**G**). The cortex (**E**) and medulla (**F**) were commonly mismatched. Another common error was to misspell ureter such that it was ambiguous with urethra. Phonetic spelling is only accepted where it is unambiguous.

(b) Although many candidates knew that filtration under pressure is the key principle only the well-prepared candidates were able to explain this in more detail. Some candidates confused the functions of the renal capsule with reabsorption that occurs along the renal tubules.

(c) There were some very good answers to this question on active transport. Candidates who were successful here referred to movement across the cell membrane against a concentration gradient. They often explained that this movement requires energy. Some stated that a protein carrier in the membrane is responsible for the movement. A common error was to state that substances flowed along or with a concentration gradient rather than against one.

(d) The only substances that are reabsorbed into the blood from the fluid in the renal tubule are water and salts. Alternatives to salts that were accepted are ions and minerals. Candidates who named suitable ions, such as sodium, also gained credit. Reference to proteins, glucose and fats were not credited.

(e) (i) The diagram of a dialysis machine in Fig. 5.1 was familiar to candidates and should have given them some help in answering these two part questions. Many candidates found completing Table 5.1 quite a challenge, although there were a number of correct combinations for each row of the table. A common error was to use the word 'normal' as one of the answers when it was not in the list of words given. This was an opportunity for candidates to work out the contents of the fresh and used dialysis fluid, in comparison with the blood before dialysis, based on what dialysis is to achieve.

(ii) The operation of the dialysis machine was frequently confused with the function of the renal capsule, for example, some candidates wrote about the application of pressure to the blood. Apart from that needed to pump the blood into the machine no extra pressure is applied to ensure filtration. More able candidates described the differences in concentrations between blood and fresh filtrate. Full credit was gained for explaining how urea is removed from the blood by diffusion through the partially permeable membranes that separate blood from dialysis fluid. The continuous flow of blood past fresh filtrate which has no urea in it means that there is always a concentration gradient and so the urea concentration of the blood can fall to near zero at the end of the dialysis session. Many candidates wrongly wrote of various solutes moving across the membrane by osmosis.

(f) The advantages of having a kidney transplant were well known. Most candidates described the freedom from regular dialysis sessions and the fact that recipients of kidney transplants no longer need to adhere to a restricted diet.

(g) The reason for tissue typing was often given as avoiding rejection. Candidates also stated the role of the immune system in rejection. References to the immune system, antibodies or white blood cells were usually given in the correct context and gained credit.

Question 6

(a) Many candidates identified **P** correctly as the atmosphere and gave carbon dioxide as the carbon compound. Fewer candidates identified parts **Q**, **R** and **S** correctly and even fewer gave correct carbon compounds. Most thought that the named compounds had to be gases and so often gave carbon dioxide for each part. **R** and **S** were the least well answered and were often left blank.

(b) After working out that **P** was the air and **Q** was a plant, candidates needed to write a straightforward account of photosynthesis. A balanced equation as part of the answer would have gained partial credit. Full credit was available to those who described the absorption of carbon

dioxide into the leaf, absorption of light and stated that reactions convert carbon dioxide and water into glucose with the production of oxygen. There were some good attempts at this question, although most omitted any reference to the absorption of carbon dioxide through stomata and its diffusion through the leaf.

(c) The Examiners looked for one of the factors that affect photosynthesis: light intensity, light duration, carbon dioxide concentration or temperature. Credit was awarded for naming a suitable factor, stating its effect on the rate of photosynthesis and for giving an explanation of that effect. Candidates who used the term *limiting factor* in their answer also gained credit.

(d) A wide variety of correct answers were seen. Factors could be any of those listed above in **(c)** but could also be providing water or nutrients, controlling humidity, providing insect pollinators and preventing pests and disease. Control devices, such as thermostats, were not credited unless they were linked to a device that could actually increase the rate of photosynthesis. An example would be a thermostat linked to heaters or ventilators.

BIOLOGY

Paper 0610/04

Coursework

Key Messages

Work that is assessed for Paper 4 must be the candidates' own, unaided work, and must be certified to be so.

Work samples must be clearly marked by the assessors, and should clearly show the mark awarded for each skill, and any changes to that mark made by internal moderation.

The external Moderators need to see every worksheet that was used for assessment, presented along with their mark schemes.

Teachers should use the Coursework Training Handbook (Part 1): Guidance for advice on all aspects of the setting, marking and submission of coursework.

General Comments

Many Centres are making good use of the coursework assessment process to help their candidates to acquire high-level skills in the areas of scientific enquiry. There was some excellent work from many candidates. While 'standard' experiments such as the effect of light intensity on photosynthesis continue to be widely and successfully used for assessment, some Centres have developed some original and interesting tasks of their own that make good use of local circumstances. It is very good to see several Centres taking candidates out of the classroom for some of these tasks, for example to carry out ecological investigations.

Centres are reminded that it is absolutely essential that the work that is assessed is each candidate's own, original, unaided work. It is not acceptable for any feedback to be given so that a candidate can redraft their work, or for candidates to work together on anything that is to be assessed. Centres should include Cambridge Coursework Authenticity forms to certify that this is the case. Work that has been redrafted after feedback, or that has been produced in collaboration with other candidates, cannot be used. Moderators like to see this original work with full comments written on it by the teacher.

For C1, the Moderators need to see evidence of how marks have been awarded. As this is ephemeral, there will be no written work from the candidates to be submitted. Centres should look in the Handbook for an example of how this evidence can be supplied.

Most Centres are now using well-constructed mark schemes. However, in a few cases, Centres are using tick list mark schemes inappropriately, simply adding up the number of ticks to determine the overall mark. Good mark schemes are essential for appropriate assessment. The Handbook provides examples of mark schemes of different styles, which can be used for reference.

BIOLOGY

Paper 0610/51

Practical Test

Key Messages

Candidates should be familiar with practical procedures outlined in the syllabus and confident using these skills in the practical tests.

To maximise credit, candidates are advised to pay particular attention to careful reading of the questions to plan the available time before starting to answer.

Many candidates still need to be reminded to select the appropriate choice of graph and to fully label axes of graphs.

Drawings need to be made using an HB pencil (not ink) so that use of an eraser can thoroughly remove all double lines. The guide line for a label must make contact with the structure intended without a gap or an arrow head. Measurements must use SI units as specified in the syllabus.

When calculations are to be made it is important that all stages are shown to illustrate the formula followed.

General comments

The Supervisor's Report is very important in ensuring that candidates are credited appropriately when alternative materials have to be substituted for those specified in the Confidential Instructions. If any difficulties arise there is time to seek advice from Cambridge Assessment about alternative materials, using the contact information on the Confidential Instructions. In cases where a substitution has been made, the Supervisor's Report should include as much detail as possible to allow Examiners to assess the candidates' answers appropriately.

Many instances were seen where able candidates lost credit for failing to fully label the graph axes. Candidates will always be expected to label graph axes using the exact terminology and units used in the question itself, or using the headings from tables supplied for the data. Small plot points should be used in the form of an 'x' that does not exceed more than half of a small square. Even when graphs have been well presented, the plotted points need to be joined carefully.

In responses to questions that require a specific number of points, it is important that candidates do not exceed the expected number as incorrect ideas may cancel acceptable and valuable answers.

Comments on specific questions

Question 1

(a) The reagent was well known, although weaker candidates did not realise that iodine is a solid and needs to be used in solution rather than adding solid iodine. As Centres used their own standard iodine solution in the practical, a variation in colour changes was accepted from yellow to brown changing to blue or blue-black. It is important to state both the original and final colour. Although many candidates knew that it would become blue/black they did not always refer to the original colour.

(b) Most candidates gained all of the available credit for recording the expected final colours for the different concentrations of reducing sugars. A number of candidates stated the colours, but without reference to concentration. A few gave incorrect information regarding the colours; some responses reported a *brown* colour for the high concentration, or shades of purple.

(c) Most candidates followed the detailed instructions to achieve a successful outcome to this investigation and recorded their individual observations of the timed samples after these had been tested for presence of starch and reducing sugars. A few candidates reversed the observation and conclusion, or did not record an observation only.

(d) For each Centre the colour changes recorded in the Supervisor's Report were checked and followed. This question was not understood by many of the candidates who failed to follow the command words and described the method of investigation, omitting to mention the observed results. A few candidates explained *either* what had happened to the starch, *or* what happened to the reducing sugars.

(e) (i) Most candidates explained the need to use a clean pipette for removing each sample to avoid mixing any of the previous extraction of a sample.

(ii) Similarly, most candidates explained the need to use a white tile for starch tests so that the background contrast enabled colour changes to be seen clearly.

(f) A control for an experiment is for comparison purposes. Most candidates confused this concept with a controlled variable and it proved difficult to describe how two further control tests could be implemented. Only a very few candidates were able to describe the use of an inactivated enzyme after denaturation or substitution by an equal volume of water. A common error made involved candidates describing further food tests for fats and proteins.

(g) It is important for candidates to read the whole question as the last word indicated the improvement required, the need to repeat the same test to demonstrate reliability. This question did not seek an overall improvement for the investigation such as constant supply of hot water for the Benedict's test.

(h) The majority of candidates could name the enzyme involved in the alimentary canal, but there were many instances of misspelling of the enzyme – in particular as *amalyse or amylse*.

(i) (i) Although this was a straightforward line graph, it was, surprisingly, not generally well done. There were many careless errors even from very able candidates. The axes needed to be labelled fully to show the full title of each axis as given in the column headings in the table of data, including the units; the scale for the axes had to be chosen to permit more than half of the printed grid to be used; each point should have been plotted using a neat, accurately positioned cross and a well-constructed (ruled) line between the plotted points or a smooth line not extending beyond these points.

(ii) Most candidates correctly suggested the optimum pH, although a significant number of candidates stated 8.5 to be the optimum pH value.

(iii) Some candidates had great difficulty describing the effect of pH. There was confusion between rate of enzyme activity and time taken for the reaction to take place, in addition to the need to explain why the enzyme was not so effective at the extremes of pH that were specified in the results. Having answered the previous question on optimum pH, it was the description either above or below this that needed to be considered, by handling the data or commenting on the slope of the curve from the graph. Reiterating the time of readings between specific data was insufficient; some comparative use of data was required.

Question 2

(a) (i) and **(ii)** Few candidates were able to indicate the position of both types of vascular tissue correctly. Xylem was most frequently mis-labelled as the parenchyma, but often the phloem was correctly labelled.

(b) The more able candidates knew that minerals were obtained by the xylem or correctly described the type of transport involved. A common error was to refer to osmosis but this term only applies to the movement of water, not mineral ions. A common error was to name both xylem and phloem or just phloem as the route.

(c) Measurements based on the line MN, located across part of the haustorium, were usually correctly shown using the named SI units and the calculation of the actual length of that part shown on the photomicrograph (×50).

(d) (i) Candidates generally followed the instructions correctly to base the labelled drawing on the part of the parasite enclosed by the rectangle on Fig. 2.3. Overall, the standard of drawings was good and most candidates labelled some of the visible features that could be viewed in the printed image. The most common correct label was the leg. It is important that the label line makes contact with the intended part of the drawing to be identified.

(ii) The group name Arachnid was seen spelt in a variety of different ways. The number of legs was the usual reason noted.

BIOLOGY

Paper 0610/52

Practical Test

Key Messages

It is important for candidates to have experience in using the practical procedures that are specified in the syllabus so they develop confidence in using these skills. In particular, understanding how results are collected and measured, so that sources of error can be recognised and ways of improving an experiment can be suggested. In questions that require a specific number of responses, candidates should not exceed the expected number.

To achieve high marks candidates:

- read questions carefully before starting to answer;
- know which SI units to use for measurements, in particular time and distance;
- show all stages in a calculation;
- label graph axes clearly with the variable being plotted, including the units and use scales which ensure that the plots occupy at least half of the grid.

General comments

The quality of work showed that candidates were thoroughly prepared for this paper as there were many examples of clear, well-presented answers.

There were some excellent examples of tables drawn carefully with a ruler and with units in the table headings. Candidates should be encouraged to use seconds to record time.

Graphs should be plotted so that most of the grid area is used. Candidates should therefore look carefully at the data so that they can choose a scale that fits the available space. Good answers used suitable scales that could be plotted accurately, poorer answers used scales that were too small or were difficult to plot, for example 10 mm = 2.4 units, or where the scale was not uniformly distributed. Plotted points need to be small and accurately placed at the plot point. The correct choice of graph to represent the data accurately is important. In this paper candidates were required to draw a straight line of best-fit, so the plotted points needed to be distributed on either side of the line.

The Supervisor's Report is very important in ensuring that candidates are credited appropriately when materials have to be substituted for those specified in the Confidential Instructions. Supervisors should trial practical materials as required by the Confidential Instructions, some time in advance of the actual examination. This gives time if any difficulties arise to seek advice about alternative materials using the contact information in the Confidential Instructions. In cases where a substitution is made, the Supervisor's Report should include as much detail as possible to allow Examiners to assess the candidates' answers appropriately.

Comments on specific questions

Question 1

This question was a practical activity that involved measuring the time taken for agar blocks of different surface area containing universal indicator to change colour. The practical skills tested were accurate measurement using SI units, preparation of a table and recording results, calculating surface area and volume, recognising experimental variables, identifying sources of error and suggesting improvements, interpreting results.

(a) Most candidates gave a correct colour change. The most common incorrect colours were orange or blue.

(b) The best answers showed a table consisting of two columns. Most candidates included additional columns that were not relevant to the results, such as number of agar blocks and surface area. Most candidates gave a suitable table heading for the independent variable, but the majority gave time in minutes for the dependent variable. The expected unit was seconds(**s**). Poorer answers often failed to include a unit in the table heading and in some cases gave an incorrect symbol, **m**, for minutes. Knowledge of SI units is essential.

(c) (i) Most candidates were able to calculate the volume of the block. Almost all candidates knew the correct unit.

(ii) During the course of study, candidates should be given practise at simple mathematical skills, including calculating surface area. Many candidates were unable to calculate surface area correctly. The most common answer was 8 cm^2, suggesting that the area of the 1 cm x 1 cm ends of the block had not been included. Showing working is important. Many candidates could not be given partial credit for knowing how to calculate surface area, even if the final answer was incorrect, as a result of not showing their working.

(iii) Better answers recognised that only the independent variable should be changed and that volume was a controlled variable. Simple statements about 'a fair test' are vague and candidates should be taught to be more specific.

(d) There were many examples of well-expressed answers gaining maximum credit. Some candidates omitted to describe the results and so could not achieve maximum credit. Poorer answers confused size and surface area and so stated that smaller blocks had less surface area, not appreciating the fact that by increasing the number of blocks, the total surface area of all the blocks in that tube was increased. Diffusion was rarely mentioned.

(e) Candidates must ensure that when answering this type of question that they make their responses specific to the investigation being discussed. General, vague answers cannot be awarded credit. When assessing sources of error, candidates should be encouraged to think about what features of the method are important in gaining reliable results. For example, in this experiment cutting the agar accurately is quite difficult and so is deciding when the colour has changed. Improvements should then show for example how obtaining accurate sized blocks could be achieved, such as using a standard cutter or mould. The improvement needs to be appropriate to the experimental set up, so a colorimeter is not suitable. Temperature was a very common answer, which in this experiment would have made little difference to the results as the time for the colour change was very short and all the tubes were measured simultaneously. When a legitimate improvement was given, often the piece of equipment suggested had been identified in 1 **(c) (i)** and so no mark could be awarded. A common misconception was that doing replicates or repeats will remove a source of error.

(f) (i) Better answers were able to relate the increase in surface area due to the action of bile to increased enzyme activity. Poorer answers confused emulsification with digestion, so a common answer was, "bile breaks down fat into smaller molecules". Another common error was to state that bile contains enzymes and even say it is acidic.

(ii) Most candidates gave a correct answer. Some poorer answers showed confusion between a control and a controlled variable.

Question 2

This question tested the practical skills of observing and interpreting information, measuring, graph plotting and experimental controls.

(a) Most candidates were able to draw an outline of a leaf. Better answers had a clear outline drawn with a sharp pencil without any gaps or shading. Labelling was often limited as candidates chose features which were not visible, such as the epidermis or large surface area. The most common correct labels were vein and midrib. Candidates should be encouraged to draw labelling lines in pencil and with a ruler and to make sure that the line touches the feature being identified. Lines

should not have arrowheads. A very common error was to label the vein with the label line ending on the lamina or midrib with the label line ending on the petiole.

(b) (i) Most candidates were able to gain credit for this question. A few candidates misinterpreted the question and gave the surface area of both sides of the leaf.

(ii) The most common correct answer was to use a grid with smaller squares. A few candidates described a suitable method of systematic counting.

(c) Most candidates realised that less light would reach the lower part of a plant, but only better answers showed the understanding that the leaves would therefore need to have a greater surface area to trap the maximum light. Another acceptable interpretation given in some answers was that leaves at the upper part of the plant had small surface areas to reduce transpiration as they are more exposed than leaves at the lower part.

(d) (i) Many candidates gained maximum credit for this part of the question. Better answers correctly used the headings from Table 2.1 as their axes labels. This is good practise and candidates should be encouraged to recognise that the first column of a table is often the independent variable and successive columns the dependent variable(s). As the data showed a correlation, it was acceptable to use either axis for total surface area of leaves.

Candidates were expected to use the whole grid to plot the data, so the most appropriate scale for the x-axis (as leaf area), was to start at 0 and for 2 cm to represent 0.05 m^2. For the y-axis (as volume of water lost), the most appropriate scale was to start a 0 and for 2 cm to represent 2 dm^3. Other scales were credited, y-axis starting from 2 dm^3 or 4 dm^3. Scales occupying less than half the grid, or using unequally spaced scales were not credited. Few had non-linear scales.

Most candidates plotted the points accurately unless an inappropriate or small scale was used or the plot points were so large that they occupied a 1 mm grid square. Candidates should be encouraged to use small crosses or dots inside circles to place plot points. These should be less than 0.5 mm^2.

Candidates were asked to draw a line of best-fit. A variety of lines were credited provided that plot points were distributed on each side of the line. For lines that passed through one plot point, candidates were expected to place two of the remaining plot points each side of the line. For lines passing through two plot points, two of the remaining plot points were expected to be on one side of the line and one on the other side of the line. A common error was to join the first, second and last plot points, leaving the remaining two on one side of the line.

(ii) Most candidates gave a correct trend, better answers also noted that the relationship was proportional or showed a positive correlation. Many candidates quoted raw data, which was not credited. Some processing of the data was expected.

(e) Many answers gained maximum credit. In some cases candidates did not achieve maximum credit as they measured in centimetres, and not in millimetres as instructed. Common incorrect answers seen were 18 mm and 19 mm. This illustrates the importance of reading the question carefully. Error carried forward was allowed for calculations using incorrect measurements. Answers were sometimes correctly rounded to 2 decimal places.

(f) Most candidates gave at least one correct answer. Better answers gave two variables, commonly temperature and humidity. Poorer answers showed a misunderstanding of the independent variable in the investigation and so answered in terms of controlling the light intensity, e.g. distance from light source/amount of light.

BIOLOGY

Paper 0610/53

Practical Test

Key Messages

Candidates should be familiar with practical procedures outlined in the syllabus and be confident using these skills in the practical tests.

To maximise credit, candidates are advised to pay particular attention to careful reading of the questions in order to plan the available time before starting to answer. The command words as specified in the syllabus must be followed so that a description is not confused with an explanation, and so on.

Many candidates still need to be reminded to select the appropriate choice of graph and to fully label axes of graphs. In this question paper, a bar-chart was to be used rather than a histogram.

Drawings need to be made using an HB pencil (not ink) so that use of an eraser can thoroughly remove all double lines. The guide line for a label must make contact with the structure intended without a gap or an arrow head. For all measurements SI units must be used as specified in the syllabus.

When calculations are to be made, it is important that all stages of working are shown to support the formula involved.

General comments

The Supervisor's Report is very important in ensuring that candidates are credited appropriately when alternative materials have to be substituted for those specified in the Confidential Instructions. If any difficulties arise there is time to seek advice from Cambridge Assessment about alternative materials, using the contact information on the Confidential Instructions. In cases where a substitution has been made, the Supervisor's Report should include as much detail as possible to allow Examiners to assess the candidates' answers appropriately.

Graphs should be plotted so that most of the grid area is used. Candidates should look carefully at the data and choose a scale that fits the available space.

Many instances were seen where able candidates lost credit for failing to fully label the graph axes. Candidates will always be expected to label graph axes using the exact terminology and units used in the question itself, or using the headings from tables supplied for the data.

In responses to questions that require a specific number of points, it is important that candidates do not exceed the expected number as incorrect ideas may cancel acceptable and valuable answers.

Comments on specific questions

Question 1

(a) After carefully reading through the instructions, most candidates completed all of the individual timed colour changes successfully for the mixture at the different temperatures in the expected order. Very few candidates experienced any problems in the completion of the outlined results table provided.

(b) (i) A chart showing the colour changes in relation to pH was included, however, not all of the candidates realised why the sodium carbonate had been added before starting the tests to follow the activity of the lipase. A common error noted referred to the idea that the mixture was 'neutralised' and yet the blue colour matched with the alkaline pH.

(ii) Most candidates described the need to allow time for the contents of each test-tube to reach the intended temperature.

(iii) A few candidates linked the observed colour change with a drop in pH of the contents as the enzyme broke down the fats in the milk to form fatty acids. The lowering of pH link was not recorded by most candidates even when it was realised that fatty acids were formed.

(iv) The temperature of 80 °C, indicated to most candidates that the enzymes would stop working, although a significant number incorrectly reported the opposite effect, that the enzyme activity would speed up the breakdown of the fats.

(c) Candidates found this question difficult to answer. It is important that candidates are aware that the term 'amount' is imprecise and there is the need to consider the volume or concentration of substrate, enzyme or indicator. The controlled volumes used in the investigation were specified as 2 cm^3 of milk, 3 cm^3 of lipase and 5 drops of indicator, but did not specify the concentrations. A few candidates realised that the observations for colour change were made at one minute intervals but the change may occur within the minute so the actual length of the reaction was not recorded.

(d) The two most common suggestions to find the optimum temperature for lipase activity were based on using a wider range of temperatures and for closer temperature intervals between the specified three as used in this investigation. A common misunderstanding was the need to prevent the water temperature for each set from warming up or cooling down with respect to the surrounding room temperature or simply to repeat the investigation.

Question 2

(a) (i) After removing the surface slice of banana candidates made a large drawing of the cut surface. Most candidates were able to draw the layers of the banana with a clear unbroken line using a sharp pencil. The irregular outer shape was often not included and a few candidates incorrectly drew concentric rings as though a compass had been used. Use of a pencil is essential so that any errors made be erased cleanly. The detail of the layers needed to be shown clearly and without any shading. The drawings were larger than that of the specimen provided as indicated by the range given in the Supervisor's Report. The label of the region where the seeds may develop was included on most drawings.

(ii) Candidates drew the line for the diameter of the section on the drawing as instructed. Two measurements were recorded for the specimen and the drawing; SI units were used, however, it was clear that a few candidates changed the unit used for this task.

(iii) Most candidates correctly calculated the magnification of their drawings based on the two measurements recorded in **(ii)**. There were some examples where a percentage calculation was incorrectly attempted. The formula to be followed should have been the diameter as shown on the drawing divided by that of the actual specimen.

(b) (i) Most candidates showed the middle layer on their drawing as changing colour after testing with iodine solution. Sometimes all of the layers were testing positive for presence of starch, not just the middle or central region.

(ii) The area within the cross section of the banana for positive starch testing was usually described correctly.

(c) (i) While many candidates presented a well-constructed proportioned bar-chart, there was some confusion between a bar-chart and a histogram. It is important that candidates should be able to present data in the correct form of a bar-chart as requested in this question. A bar-chart is intended to show columns spaced evenly along one labelled axis to show each type of nutrient involved, and the mass of each type of nutrient in g per 100 g of nutrients on the other linearly and evenly scaled axis, to cover the full range of data provided within the printed grid. The type of nutrient columns should be accurately drawn, of equal width and spaced evenly with a single scale

for each axis. The final bar-chart should not extend beyond the printed grid but should make full use of the area available. Shading in these columns for a single set of data is not necessary and tends to obscure the accuracy and appearance.

(ii) Most candidates correctly calculated the mass of water in 100 g of banana.

(d) (i) The majority of candidates correctly calculated how many times greater the reducing sugar content was on day 6 compared with day 1.

(ii) Candidates easily suggested one feature of ripe bananas that would attract animals.

BIOLOGY

Paper 0610/61
Alternative to Practical

Key Points

Candidates should be familiar with practical procedures outlined in the syllabus.

In **Question 1** there was the need to describe safe procedures for food tests; to recall and explain practical procedures; draw conclusions based on results and to present data in correct graphical form.

In **Question 2** candidates were given photographs of specimens and they had to make observations; to present accurate, labelled drawings; to measure distance using correct SI units and use observational skills to classify an animal.

General comments

Overall candidates were well prepared to answer the questions and these were generally answered in accordance with the instructions given.

It is important that candidates use a good HB pencil and eraser for drawings and graph construction.

Drawings should have a clear continuous outline and be labelled. The guide line for a label must make contact with the structure intended without a gap. Magnifications based on the photographed image require accurate measurements, in SI units not imperial, for the calculation.

Food tests need to record the starting colour when noting the changes if certain foods type are present.

When plotting, graphs need to be scaled so that the plots fit and use most of the available grid (with plots covering more than half of the available grid in both dimensions). The correct choice of graph to represent the data accurately is important and in this paper candidates were required to present the data as a line graph with clearly labelled axes.

Comments on specific questions

Question 1

This first question involved knowledge and understanding of practical procedures, handling data and drawing conclusions. It had the largest proportion of marks for this paper.

(a) Most candidates were familiar with the use of iodine solution to test for starch. The most common error was to use iodine instead of iodine solution or drops of iodine. Iodine is a solid and needs to be dissolved in potassium iodide solution for the starch test. It is important to state both the original and final colour. Although many candidates knew that it would become blue / black they did not refer to the original colour.

(b) Candidates were asked to describe how they would safely carry out a test for reducing sugars. The safety features were well known and many were given. A small number of weaker candidates, not familiar with the test only gained a mark for listing safety features.

Most candidates correctly used Benedict's solution. A small number did not heat the mixture. A large number of candidates correctly used a water bath, but a small number incorrectly used a warm water bath or a water bath with no reference to heat, which gained the safety mark but not

the mark for heating. Again, they were required to describe the complete colour change to gain a mark for the results but many candidates only gave the final colour.

(c) Candidates were asked to suggest why the starch and enzyme solutions were kept at 35 °C. This was well answered. The idea that this needs to be the temperature at which the enzyme works best was well understood. A common error was to say that 35 °C was body temperature without linking it to the working of the enzyme. Another incorrect suggestion was to prevent the enzyme from becoming denatured.

(d) (i) Five reducing sugar tests were completed and the candidates were given a table in which the conclusions for the results were given. The candidates had to complete the table by writing in the observations that they would expect for each conclusion. Many candidates were familiar with this test and gave all the correct expected colour changes. Some candidates failed to gain the first mark by saying 'no change' instead of giving the starting colour. The end colour was well known but some candidates confused the middle three colours. Weaker candidates did not give any colours at all but gave vague descriptions of changes or numbers of bubbles. A small number completed the table with colour changes expected for the test for starch.

(ii) The candidates were told that the observations for the starch test were all brown and asked to draw a conclusion. Many candidates correctly concluded that there was no starch present. A common error was to say that a small amount of starch was present. A number of candidates tried to explain the results. Some candidates did not realise that the solution tested was taken from the large test- tube outside the tubing and incorrectly explained the result by saying that the starch had been broken down.

(e) Candidates were asked to explain the results of the investigation over the 40 minutes. The more able candidates and those candidates familiar with this type of practical answered this well and were able to gain most of the marks. These candidates linked the two sets of results and realised that the starch had been broken down into reducing sugars and the smaller molecules of sugar were able to diffuse through the partially permeable tubing. For these candidates, the most common omission was the reference to the membrane of the tubing which allowed the process to happen. A small number of candidates confused diffusion with osmosis.

(f) (i) Candidates were asked to explain why the outside of the tubing was rinsed before it was placed in the large test-tube of water. In general, candidates struggled with this question part. The procedure was carried out to prevent the consequences of spillage of the starch and enzymes when they were placed in the tubing. Answers were often explained in terms of the tubing being cleaned but not give any further detail.

(ii) Candidates were asked to explain why a white tile was used for the starch test. Overall this was understood although the answers were sometimes not expressed well. The more able candidates realised that it would enable any colour change to be seen more easily. Many candidates did know that it was about colour but did not make it obvious that it was to help us see the colour change. Others did not qualify their answers to say that it would be seen more easily on a white tile. A colour change would be seen on any background but it would be more easily seen on a white background. A common error was to refer to results rather than a colour change being seen.

(g) (i) Candidates were asked to suggest a region of the alimentary canal represented by the tubing. The more able candidates, who understood the investigation, were able to gain marks here but the majority of candidates did not answer this well. Most candidates focused on the digestion of starch rather than its absorption. For this reason the mouth and pancreas, both associated with the digestion of starch, were frequently seen. A large number of candidates correctly chose the small intestine or duodenum but still linked their answer to the digestion of starch. Liver and large intestine were common errors.

(ii) Amylase was quite well known as the enzyme which works in the alimentary canal to breakdown starch. A small number of candidates, incorrectly, spelt it as amalyse which was not accepted. Maltase and carbohydrase were also seen, as well as ptyalin for salivary amylase.

(h) (i) Using the measurements from **Table 1.2**, candidates were asked to plot a graph to show the results for the investigation of the effect of pH on the activity of the enzyme. A line graph was most suitable as both variables are continuous with interval data. A very small number of candidates drew bar charts or histograms.

Overall the graphs were well constructed. The majority of candidates placed pH on the x-axis and time on the y-axis. This best showed the effect of pH on the activity but either orientation was accepted.

Ideally, the axes should be labelled with the headings (including units) from the table, but 'time / minutes' and pH were accepted. A small number of candidates failed to give the units for time or abbreviated minutes incorrectly to 'm'. Candidates must be taught to use the correct SI units.

The values for data must be evenly spaced on each axis so that the plotted points make full use of the whole printed grid. Most candidates did use an even scale and made full use of the grid. A small number of candidates labelled 0 on the axes but then failed to use a discontinuity mark with the result that their scale was uneven, the greatest difference between values being at the beginning.

The majority of candidates plotted the points accurately and only a small number of errors were seen, such as the omission of pH 6.6.

Smooth free-hand lines to form an accurate curve or ruled lines, both connecting all points were accepted. The majority of candidates did join the points as expected. Those curves drawn to try and show a smooth curve by missing plots, often resulted in an extended curve with an exaggerated trend. A small number of candidates extrapolated their lines beyond the data values. This is incorrect.

(ii) Having plotted the graph, candidates were asked to suggest the optimum pH for the enzyme. Most candidates correctly identified pH 7 from the graph. A small number of candidates confused time and rates of reaction and so chose pH 8.5 as this was the highest point on their graph.

(iii) Candidates were asked to describe the effect of pH on the activity of the enzyme. The better candidates used the graph to describe the trends which were very distinct before and after pH 7 and these candidates gained the first two marks. Common errors were to state a number of individual pH values or areas of acidity or alkalinity e.g. pH 4 or low acid and describe the activity or length of time. These were disjointed and did not show the effect of pH. A description of the trend e.g. 'as pH increases to 7 the activity increases' best shows the effect of pH on the enzyme. Again, a common error was to confuse the time taken as the rate and so the opposite effect was described. Candidates should be taught to use comparative figures in their responses and not simply quote the data from the table. A small number of candidates identified that the alkaline trend was 'steep' but did not compare this to the acidic trend.

(iv) Candidates were asked to suggest a suitable control for this experiment. This is an area that candidates need more practise on as the majority of candidates described the idea of controlling variables e.g. pH or temperature rather than describing a control experiment. The most common correct answer was the use of boiled enzyme but it was not recognised by many candidates. A number of more able candidates did know that for the control the enzyme should be omitted but they did not replace it with an equal amount of water and so it was not a comparable test.

Question 2

(a) The candidates were given a photograph showing a microscopic section through the stem of gorse with dodder attached, **Fig. 2.2**, and they had to label the xylem and the phloem. Candidates need exposure to a variety of different views of plant (and animal) sections throughout the course of study so that they are not deterred by an unfamiliar example such as this. Wide exposure is essential for examination preparation.

(b) Candidates were asked to suggest how dodder obtains minerals from the gorse. The better candidates did know that minerals were obtained from the xylem and there were quite a few good answers describing diffusion or active transport. A common error was to refer to osmosis but this term only applies to the movement of water, not mineral ions. The less able candidates simply referred to the stem or roots.

(c) Candidates were required to measure the length of **MN**, a line on the photograph which showed the width of the haustorium. Most measurements were accurate. Given that the magnification of the photograph was x 50, they were asked to calculate the actual width in milimetres. This was very

well answered. The majority of candidates calculated this correctly. To calculate the actual width it is important for candidates to know that the length of the image needs to be divided by the magnification. A small number used the magnification incorrectly and multiplied the length of **MN** by 50.

(d) (i) A photograph of a parasitic arthropod was provided, **Fig. 2.3**. Candidates were instructed to make a large, labelled drawing of the part of the parasite in the rectangle. Overall, the standard of drawings was good although there were a small number which bore very little resemblance to the photograph.

The lines used to draw the head end of the parasite were good, mainly single and clear. A clear unbroken outline was needed. There were very few artistic lines and there was very little shading (both of which should be avoided in biological drawings).

Most drawings were of a reasonable size, larger than the photograph. An ideal size would be using most of the space provided. A few candidates attempted to draw the whole specimen and so the size of the required part in the rectangle was too small.

Most candidates accurately represented the mouthparts and the jointed legs. The most common error was to draw smooth, continuous legs and not to show the joints which were visible from the outline of the legs in the photograph. There is always at least one mark for the detail of a biological drawing. Therefore candidates must endeavour to represent the specimen as accurately as possible.

Most candidates correctly labelled the drawing. It is important that any label line touches the part of the drawing it is identifying. A number of marks were lost for label lines not touching the drawing.

(ii) Candidates were asked to name the group of arthropods to which the animal in **Fig. 2.3** belonged and give a reason for their answer. This was quite well known, many candidates correctly identifying it as an arachnid because of its four pairs of legs. A small number correctly identified that it had two parts to its body. Candidates who did not know it was an arachnid usually gave insect or crustacean and incorrectly linked it to having four pairs of legs.

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Paper 0610/62
Alternative to Practical

Key Messages

Candidates should be familiar with practical procedures that are specified in the syllabus. In particular, understanding how results are collected and measured, so that sources of error can be recognised and ways of improving an experiment can be suggested. In questions that require a specific number of responses, candidates should not exceed the expected number.

To achieve high marks candidates:

- read questions carefully before starting to answer;
- know which SI units to use for measurements, in particular time and distance;
- show all stages in a calculation;
- label graph axes clearly with the variable being plotted, including the units and use scales which ensure that the plots occupy at least half of the grid.

General Comments

The quality of work showed that candidates were thoroughly prepared for this paper as there were many examples of clear, well-presented answers.

There were some excellent examples of tables drawn carefully with a ruler and with units in the table headings.

Candidates should be encouraged to use seconds to record time.

Graphs should be plotted so that most of the grid area is used. Candidates should therefore look carefully at the data so that they can choose a scale that fits the available space. Good answers used suitable scales that could be plotted accurately, poorer answers used scales that were too small or were difficult to plot, for example 10 mm = 2.4 units, or where the scale was not uniformly distributed. Plotted points need to be small and accurately placed at the plot point. The correct choice of graph to represent the data accurately is important. In this paper candidates were required to draw a straight line of best-fit, so the plotted points needed to be distributed on either side of the line.

Comments on Specific Questions

Question 1

The candidates were presented with an investigation into the effect of surface area on the rate of digestion of food by observing the colour change in agar jelly pieces placed in dilute sulphuric acid.

The practical skills tested were calculating surface area and volume, preparation of a table and recording results, interpreting results, recognising experimental variables, identifying sources of error and suggesting improvements.

(a) Most candidates gave a correct colour change. A range of incorrect colours was seen, mainly blue with some giving orange.

(b) (i) During the course of study, candidates should be given practise at simple mathematical skills, including calculating surface area. Many candidates were unable to calculate surface area

correctly. The most common answer was 8 cm^2, suggesting that the area of the 1 cm x 1 cm ends of the block had not been included. Showing working is important. Many candidates could not be given partial credit for knowing how to calculate surface area, even if the final answer was incorrect, as a result of not showing their working.

(ii) Most candidates were able to calculate the volume of the block. Almost all candidates knew the correct unit.

(c) (i) While many scored 1 mark for correctly naming two pieces of apparatus (usually stopwatch and measuring cylinder), errors included safety features, universal indicator, or named only one feature.

(ii) The best answers showed a table consisting of two columns. Most candidates included additional columns that were not relevant to the results, such as number of agar blocks and surface area. Most candidates gave a suitable table heading for the independent variable, but the majority gave time in minutes for the dependent variable. The expected unit was seconds(**s**). Poorer answers often failed to include a unit in the table heading and in some cases gave an incorrect symbol, **m**, for minutes. Knowledge of SI units is essential.

(d) There were many examples of well-expressed answers gaining maximum credit. Many recognised tube D as an anomaly, and attempted to explain it. Some candidates omitted to describe the results and so could not achieve maximum credit. Poorer answers confused size and surface area and so stated that smaller blocks had less surface area, not appreciating the fact that by increasing the number of blocks, the total surface area of all the blocks in that tube was increased. Diffusion was rarely mentioned.

(e) Better answers recognised that only the independent variable should be changed and that volume was a controlled variable. Simple statements about 'a fair test' are vague and candidates should be taught to be more specific.

(f) Candidates must ensure that when answering this type of question that they make their responses specific to the investigation being discussed. General, vague answers cannot be awarded credit. When assessing sources of error, candidates should be encouraged to think about what features of the method are important in gaining reliable results. For example, in this experiment cutting the agar accurately is quite difficult and so is deciding when the colour has changed. Improvements should then show for example how obtaining accurate sized blocks could be achieved, such as using a standard cutter or mould. The improvement needs to be appropriate to the experimental set up, so a colorimeter is not suitable. Temperature was a very common answer, which in this experiment would have made little difference to the results as the time for the colour change was very short and all the tubes were measured simultaneously. When a legitimate improvement was given, often the piece of equipment suggested had been identified in 1 **(c) (i)** and so no mark could be awarded. A common misconception was that doing replicates or repeats will remove a source of error.

(g) (i) Better answers were able to relate the increase in surface area due to the action of bile to increased enzyme activity. Poorer answers confused emulsification with digestion, so a common answer was, "bile breaks down fat into smaller molecules". Another common error was to state that bile contains enzymes and even say it is acidic.

(ii) The idea of a control/comparison was often correctly stated, or described by saying 'in order to see the effect with or without the enzyme'. Some poorer answers showed confusion between a control and a controlled variable.

Question 2

This question tested the practical skills of observing and interpreting information, measuring, graph plotting and experimental controls.

(a) The most common correct labels were vein and midrib. Candidates should be encouraged to draw labelling lines in pencil and with a ruler and to make sure that the line touches the feature being identified. Lines should not have arrowheads. A very common error was to label the vein with the label line ending on the lamina or midrib with the label line ending on the petiole.

(b) (i) This question part was generally well answered, giving figures within the accepted range. Often a correct answer was given without any indication on the leaf as to how the area was obtained. A few candidates misinterpreted the question and gave the surface area of both sides of the leaf.

(ii) The most common correct answer was to use a grid with smaller squares. A few candidates described a suitable method of systematic counting.

(c) Most candidates realised that less light would reach the lower part of a plant, but only better answers showed the understanding that the leaves would therefore need to have a greater surface area to trap the maximum light. Another acceptable interpretation given in some better answers was that leaves at the upper part of the plant had small surface areas to reduce transpiration as they are more exposed than leaves at the lower part.

(d) (i) Many candidates gained maximum credit for this part of the question. Better answers correctly used the headings from Table 2.1 as their axes labels. This is good practise and candidates should be encouraged to recognise that the first column of a table is often the independent variable and successive columns the dependent variable(s). As the data showed a correlation, it was acceptable to use either axis for total surface area of leaves.

Candidates were expected to use the whole grid to plot the data, so the most appropriate scale for the x-axis (as leaf area), was to start at 0 and for 2 cm to represent 0.05 m^2. For the y-axis (as volume of water lost), the most appropriate scale was to start a 0 and for 2 cm to represent 2 dm^3. Other scales were credited, y-axis starting from 2 dm^3 or 4 dm^3. Scales occupying less than half the grid, or using unequally spaced scales were not credited. Few had non-linear scales.

Most candidates plotted the points accurately unless an inappropriate or small scale was used or the plot points were so large that they occupied a 1 mm grid square. Candidates should be encouraged to use small crosses or dots inside circles to place plot points. These should be less than 0.5 mm^2.

Candidates were asked to draw a line of best-fit. A variety of lines were credited provided that plot points were distributed on each side of the line. For lines that passed through one plot point, candidates were expected to place two of the remaining plot points each side of the line. For lines passing through two plot points, two of the remaining plot points were expected to be on one side of the line and one on the other side of the line. A common error was to join the first, second and last plot points, leaving the remaining two on one side of the line.

(ii) Most candidates gave a correct trend, better answers also noted that the relationship was proportional or showed a positive correlation. Many candidates quoted raw data, which was not credited. Some processing of the data was expected.

(e) Many answers gained maximum credit. In some cases candidates did not achieve maximum credit as they measured in centimetres, and not in millimetres as instructed. Common incorrect answers seen were 18 mm and 19 mm. This illustrates the importance of reading the question carefully. Error carried forward was allowed for calculations using incorrect measurements. Answers were sometimes correctly rounded to 2 decimal places.

(f) Most candidates gave at least one correct answer. Better answers gave two variables, commonly temperature and humidity. Poorer answers showed a misunderstanding of the independent variable in the investigation and so answered in terms of controlling the light intensity, e.g. distance from light source/amount of light.

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Alternative to Practical

Key Messages

Candidates should be familiar with practical procedures outlined in the syllabus and be confident using these skills.

To maximise credit, candidates are advised to pay particular attention to careful reading of the questions in order to plan the available time before starting to answer. The command words as specified in the syllabus must be followed so that a description is not confused with an explanation, and so on.

Many candidates still need to be reminded to select the appropriate choice of graph and to fully label axes of graphs. In this question paper, a bar-chart was to be used rather than a histogram.

Drawings need to be made using an HB pencil (not ink) so that use of an eraser can thoroughly remove all double lines. The guide line for a label must make contact with the structure intended without a gap or an arrow head. For all measurements SI units must be used as specified in the syllabus.

When calculations are to be made, it is important that all stages of working are shown to support the formula involved.

General comments

The quality of work showed that candidates were prepared for this paper as there were many examples of clear well-presented answers.

Graphs should be plotted so that most of the grid area is used. Candidates should look carefully at the data and choose a scale that fits the available space.

Many instances were seen where able candidates lost credit for failing to fully label the graph axes. Candidates will always be expected to label graph axes using the exact terminology and units used in the question itself, or using the headings from tables supplied for the data.

In responses to questions that require a specific number of points, it is important that candidates do not exceed the expected number as incorrect ideas may cancel acceptable and valuable answers.

Comments on specific questions

Question 1

(a) After carefully reading through the introduction, most candidates successfully completed the transfer of data from details shown in a candidates' result notes to record the temperature, times at which the results were recorded, and all of the individual colour changes successfully for the mixture at the three different temperatures in the expected order. Very few candidates experienced any problems in transferring the data provided.

(b) (i) A chart showing the colour changes in relation to pH was included, however, not all of the candidates realised why the sodium carbonate had been added before starting the tests to follow the activity of the lipase. A common error noted referred to the idea that the mixture was 'neutralised' and yet the blue colour matched with the alkaline pH.

(ii) Most candidates described the need to allow time for the contents of each test-tube to reach the intended temperature.

(iii) Few candidates linked the observed colour change of the indicator with a drop in pH of the contents of each test-tube as the enzyme broke down the fats in the milk to form fatty acids. The lowering of pH link was not recorded by most candidates even when it was realised that fatty acids were formed.

(iv) The temperature of 80 °C, indicated to most candidates that the enzymes would stop working, although a significant number incorrectly reported the opposite effect, that the enzyme activity would speed up the breakdown of the fats.

(v) The anomalous result in the table was the green colour at 8 minutes followed by a further blue observation at 10 minutes for the 21 °C middle tube. Some candidates omitted the details that identified this error.

(c) Candidates found this question difficult to answer. It is important that candidates are aware that the term 'amount' is imprecise and there is the need to consider the volume or concentration of substrate, enzyme or indicator. The controlled volumes used in the investigation were specified as 2 cm^3 of milk, 3 cm^3 of lipase and 5 drops of indicator, but did not specify the concentrations. A few candidates realised that the observations for colour change were made at one minute intervals but the change may occur within the minute so the actual length of the reaction was not recorded.

(d) The two most common suggestions to find the optimum temperature for lipase activity were based on using a wider range of temperatures and for closer temperature intervals between the specified three as used in this investigation. A common misunderstanding was the need to prevent the water temperature for each set from warming up or cooling down with respect to the surrounding room temperature or simply to repeat the investigation.

Question 2

(a) (i) Most candidates were able to draw the layers of the banana with a clear unbroken line using a sharp pencil. The irregular outer shape was often missed and a few candidates incorrectly drew concentric rings as though a compass had been used. Use of a sharpened pencil is essential so that any errors made be erased cleanly. The detail of the layers needed to be shown clearly and without any shading. The drawings were larger than illustrated in Fig. 2.1. The label of the region where the seeds may develop was included on most drawings.

(ii) Candidates drew a line for the diameter and measured the length of the line on both sections from Fig. 2.1 and their drawing as instructed. The units were not given on the question paper but SI units, (mm), as specified in the syllabus should have been used. However, it was clear that some candidates recorded the measurement in centimetres.

(iii) Most candidates correctly calculated the magnification of their drawings based on the two measurements recorded in **(ii)**. There were some examples where a percentage calculation was incorrectly attempted. The formula to be followed should have been the diameter as shown on the drawing divided by that of the specimen in Fig. 2.1.

(b) Most candidates referred to the colour of middle layer in Fig. 2.2 after testing with iodine solution as being an indication of the presence of starch.

(c) (i) While many candidates presented a well-constructed proportioned bar-chart, there was some confusion between a bar-chart and a histogram. It is important that candidates should be able to present data in the correct form of a bar-chart as requested in this question. A bar-chart is intended to show columns spaced evenly along one labelled axis to show each type of nutrient involved, and the mass of each type of nutrient in g per 100 g of nutrients on the other linearly and evenly scaled axis, to cover the full range of data provided within the printed grid. The type of nutrient columns should be accurately drawn, of equal width and spaced evenly with a single scale for each axis. The final bar-chart should not extend beyond the printed grid but should make full use of the area available. Shading in these columns for a single set of data is not necessary and tends to obscure the accuracy and appearance.

(ii) Most candidates correctly calculated the mass of water in 100 g of banana.

(d) (i) Most candidates chose either day 4 for the skin colour becoming yellow or day 5 for the maximum sugar content.

(ii) The majority of candidates correctly calculated how many times greater the reducing sugar content was on day 5 compared with day 1.

(iii) The source of the reducing sugar was not always correctly given as the starch that been tested for in part **(b)**. Many candidates referred to the fruit as a whole, or to the process of photosynthesis.

(iv) Candidates were able to suggest two features of ripe bananas that would attract animals.