BIOLOGY

Paper 0610/11
Multiple Choice

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

General comments

The majority of candidates were able to cope very well with most of the questions on this paper. A small minority selected correct responses to all questions and are to be congratulated.

Comments on specific questions

Question 1 A significant number of candidates overlooked the fact that the removal of carbon dioxide from respiration is also an excretory process, and thus incorrectly chose option **C**.

Question 2 Almost all candidates knew that insects have six legs, however, a considerable number believed that insects have only two body parts.

Question 10 Whilst it is true that water enters cells by osmosis, many candidates, even otherwise competent ones, did not appreciate that cells of the mesophyll in a leaf receive their water, by osmosis, from the xylem within the leaf, not from the water that has just evaporated from their surfaces. This led to option **A** being a popular, but incorrect choice.

Question 20 Candidates at this level commonly believe that we 'breathe in oxygen and breathe out carbon dioxide' and are unfamiliar with the fact that the oxygen and carbon dioxide content of inspired and expired air changes by only about 4% in each case. The nearest figures to those of the misheld belief were offered as option **A** which was selected by a considerable minority of the candidates.

Question 23 There were several problems to be solved here, and it proved too great a task for many. Candidates need to realise how alcohol reaches the liver, what happens to it there, and then what happens to alcohol (a toxin) in the blood as it passes through the kidneys. Even some otherwise capable candidates became confused, and opted to suggest that the hepatic portal and hepatic veins would have a low alcohol level, whilst the renal artery would have a high level; this is almost the reverse of the true situation. In this case, they may not have considered that the alcohol, being still in the stomach, would not (yet) have entered the hepatic portal vein.

Question 29 This was a relatively straightforward question based on graph interpretation and it proved to be the easiest on the paper. Although there was nothing particularly taxing for candidates, it is often in the interpretation of graphs that many problems are revealed, and thus the candidates' performances on this question is to be complimented.

Question 37 This was another relatively straightforward question based on graph interpretation. The only contender to the correct answer was option **C**, where the population curve begins to show signs of rising, but, having appreciated this fact, it is difficult to understand why that should have been more popular than the steep rise that immediately follows.

BIOLOGY

Paper 0610/12
Multiple Choice

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

General comments

The majority of candidates were able to cope very well with most of the questions on this paper. A significant number chose correct responses to all questions and are to be congratulated.

Comments on specific questions

Question 1 Almost all candidates knew that insects have six legs, but a considerable minority believed that insects have only two body parts.

Question 3 A significant number of candidates overlooked the fact that the removal of carbon dioxide from respiration is also an excretory process, and thus incorrectly chose option **C**.

Question 7 Although this proved to be a relatively easy question, it was significantly the better candidates who answered it correctly. It may be that they were the ones who realised that the first two columns alone provided the answer.

Question 8 Whilst it is true that water enters cells by osmosis, many candidates, even otherwise competent ones, did not appreciate that cells of the mesophyll in a leaf receive their water, by osmosis, from the xylem within the leaf, not from the water that has just evaporated from their surfaces. This led to option **A** being a popular, but incorrect choice.

Question 18. Candidates at this level commonly believe that we 'breathe in oxygen and breathe out carbon dioxide' and are unfamiliar with the fact that the oxygen and carbon dioxide content of inspired and expired air changes by only about 4% in each case. The nearest figures to those of the misheld belief were offered as option **A** which was selected by a considerable minority of the candidates.

Question 23 This question revealed that some of the less able candidates believe that amino acids are excreted in urine. It may, however, have been not reading the question properly that led so many to see the term 'amino acids' and, knowing that they are basic constituents of proteins, select that answer without further thought.

Question 29 This was the easiest question on the paper. Although graph interpretation can often pose problems, candidates were able to negotiate this particular example most competently.

Question 39 This was another relatively straightforward question based on graph interpretation. The only contender to the correct answer was option **C**, where the population curve begins to show signs of rising, but, having appreciated this fact, it is difficult to understand why that should have been more popular than the steep rise that immediately follows.

BIOLOGY

Paper 0610/13
Multiple Choice

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

General comments

The majority of candidates were able to cope very well with most of the questions on this paper. A significant number selected correct responses to all questions and are to be congratulated.

Question 5 Many biology candidates panic when faced by even the simplest of mathematical skills, however, in this question none of the candidates were attracted to options **C** or **D**, thus displaying level-headed thinking.

Question 11 Whilst it is true that water enters cells by osmosis, many candidates, even otherwise competent ones, did not appreciate that cells of the mesophyll in a leaf receive their water, by osmosis, from the xylem within the leaf, not from the water that has just evaporated from their surfaces. This led to option **A** being a popular, but incorrect choice.

Question 12 This simple piece of graph interpretation posed almost no problems for the candidates.

Question 16 As with **Question 12**, a simple exercise in graph interpretation was not a problem for this able group of candidates making this, and **Question 12**, the easiest on the paper.

Question 24 It was evident that many candidates were not aware that rotating the plant would eliminate the effect of gravity, and were also somewhat confused, in the incorrect options, by the introduction of the effect of light. This may have led some otherwise able candidates to select option **D** as the answer, even though the stem in a normal upright position would still be subject to gravitational forces.

Question 29 This was a relatively straightforward question based on graph interpretation and followed the trend of **Questions 12** and **16**. Although there was nothing particularly taxing for candidates, it is often in the interpretation of graphs that many problems are revealed, and thus the candidates' performances on this question is to be complimented.

Question 34 Many candidates incorrectly chose option **D**. However, although respiration produces carbon dioxide, it is not then *directly* used by animals until plants have converted it into carbohydrate, which they use themselves. This is then passed on to other organisms in food chains. It was significant that it was the better candidates who realised this, while the less able, knowing that respiration releases carbon dioxide, assumed that this was the answer to the question.

Question 39 The link between nuclear radiation and mutation was soundly understood by almost all candidates.

BIOLOGY

Paper 0610/21
Core Theory

Key Message

Candidates should be aware of the need to read each question thoroughly and to take note of the demands of each section before beginning their response. Reading the instruction carefully is vital if the response is to fit the question.

Handwriting should be clear and mistakes should be clearly crossed out and written again.

General comments

There were very few cases where candidates failed to attempt whole sections of a question and little evidence that candidates had insufficient time to complete the paper. There were candidates who showed very limited knowledge and understanding of some topics from the syllabus, especially the eye (**Question 2**) and flower and seed structure (**Question 4**). Most candidates appeared to find the paper demanding in at least some of its aspects. There was evidence in a number of places, that candidates had not read the questions carefully or thoroughly enough. Some responses, although on the topic, failed to answer the question asked. Many candidates found it difficult to explain how or why biological phenomena occurred although their basic knowledge was adequate. In a significant number of cases, candidates' handwriting was very hard to interpret. It should be noted that illegible work cannot be awarded credit. Over-written work and very small writing presents problems especially when the spelling of a term is crucial to the biology.

Question 1

Many candidates gained full credit on this question. In **(a)** some quoted common names such as snakes rather than the names of vertebrate classes and a number thought amphibians had a scaly skin.

Question 2

Very few candidates were able to identify the structures in the eye correctly. Some did identify the iris, **X**, but **Z** should have been named as the optic nerve. It was insufficient to call it a sensory nerve. Part **(b)** was poorly answered with many candidates confusing the roles of the iris muscles with those of the ciliary muscles. Some candidates described the mechanism for focussing on a distant object but did not go on to describe how this was changed to focus on the diagram, which was the essence of the question. Many seemed to think the role of the iris was critical. In **(c)**, the graph was usually well drawn although some candidates failed to gain full credit as they extrapolated back below the age of 10 unnecessarily and incorrectly. Most were able to extract data from their graphs correctly. A few candidates failed to label the axes of their graphs although they had inserted scales.

Question 3

Knowledge of the consequences of a blockage in the coronary artery was good, although a few talked about disruption to the blood flow through the heart. Many candidates also made sensible suggestions about measures a person could take to reduce the risk of such a clot forming. The commonest responses were to reduce the amount of animal fats in the diet, stop smoking and take more exercise. Candidates should realise that instructions such as 'stop stress' unless explained are not practicable and ideas such as having a healthy or balanced diet or visiting the doctor are not specific enough.

Question 4

The parts of the pea fruit were often not known, and in **(b)** many did not label the parts of the seed. Very few identified the radicle, plumule and testa correctly. Part **(c)** was about dispersal of seeds but many responses were in terms of pollination. Mechanisms or agents of dispersal were acceptable responses, but it should be noted that insects are not usually agents for seed dispersal. In **(d)**, both external and internal factors, needed for seeds to germinate, were acceptable, but few candidates mentioned any of the latter. Many incorrectly thought that light and the presence of carbon dioxide were essential for germination to occur. Light is not a trigger for germination in the majority of plant species. These factors only become important when the shoot emerges and photosynthesis begins, i.e. after germination has occurred. 'Temperature' could not gain credit without being further explained.

Question 5

Knowledge of the carbon cycle was quite good. Most realised that arrow **A** represented respiration and that **E** was combustion. 'Burning' was accepted for the latter but 'breathing' was too vague for the former. Most candidates could name a suitable group of organisms in **(b)(i)** and many mentioned the need for water, oxygen or a suitable temperature in **(b)(ii)**. A significant number of candidates could not complete the word equation for photosynthesis in **(c)(ii)**. Many gave solar energy as the form of energy needed. This is not a correct term for the visible spectrum of light emitted from the Sun which is used in photosynthesis. In **(d)** most candidates attempted a response but had difficulty expressing their ideas clearly. The majority could only say that light energy could not be recycled. A minority utilised the carbon cycle to explain that the carbon dioxide taken from the atmosphere in photosynthesis is eventually released back into it by respiration, decomposition and combustion and thus can be recycled.

Question 6

Very few candidates dealt well with questions that began with 'explain'. In **(a)** many linked the rise in temperature to the heart beating faster or to an increased pulse rate. A full explanation required noting that the rise in energy demand and increased respiration lead to extra heat being generated. Some suggested that the heat was dispersed more rapidly or that sweating increased. A simple definition was required in **(b)(i)** but many gave statements that were too vague such as 'how temperature is controlled'. Responses for part **(b)(ii)** showed some understanding of the topic but many responses were inaccurate. It should be noted that only the water in sweat evaporates, although most knew that sweating helps to reduce body temperature.

Question 7

Candidates who knew the difference between mitosis and meiosis usually scored highly on this question. A few got the two processes the wrong way round but many were able to display their knowledge and understanding in this question format.

Question 8

In spite of the instruction to tick three boxes, a significant number of candidates ticked four (or more) boxes. This meant that at least one response was incorrect and thus the candidate could not gain full credit. A number also filled in all the boxes by naming the parts indicated, again failing to answer the question. In **(b)** most were able to describe the functions of two suitable features. Most knew that red blood cells lack a nucleus and also that they transport oxygen around the body.

Question 9

In **(a)** candidates' responses usually showed that they were familiar with the two terms but most did not fully describe the differences between them. Most correctly identified a carnivore and a producer in **(b)**, but many incorrectly thought that the secondary consumers, the lizards, bats and snakes, would be found in the second tropic level, suggesting that they had confused the two terms. Part **(c)** was usually well answered, although a minority misunderstood the food web and suggested that the deer fed on the mountain lions and would now have to eat more coyotes.

BIOLOGY

Paper 0610/22
Core Theory

Key Message

Candidates should be aware of the need to read each question thoroughly and to take note of the demands of each section before beginning their response. Reading the instruction carefully is vital if the response is to fit the question.

Handwriting should be clear and mistakes should be clearly crossed out and written again.

General comments

This year there were fewer candidates who did not attempt all parts of all questions. There did not appear to be a lack of time to complete the paper. However, there were candidates who showed very limited knowledge and understanding of some topics from the syllabus. Specifically, candidates seemed to have very limited knowledge and understanding of the role of the liver and kidney, the placenta and how environmental factors affect transpiration. Most candidates appeared to find the paper demanding in at least some of its aspects. Responses to various sections of questions revealed certain misconceptions and misunderstandings. There was evidence in a number of places, indicated in the comments on specific questions, that candidates had not read the questions carefully or thoroughly enough and thus their responses were inadequate or off the point. Candidates should be made aware of the need to read the questions thoroughly and to take note of each question's demands.

Comments on specific questions

Question 1

Many candidates had difficulty in distinguishing between annelids and nematodes but a few could not do the relatively simple task of correctly linking insects to the relevant description. The commonest correct responses were for the insects and molluscs.

Question 2

In part **(a)**, many responses showed confusion between excretion and egestion. Candidates should be aware of the difference between these two processes. A significant number of candidates understood that waste materials removed from the body were formed by the body's metabolic processes, and that the end products of these processes were often toxic. Although most candidates recognised that carbon dioxide was the main excretory product in expired air, a significant number of responses suggested that nitrogen, which is inhaled, carbon monoxide and hydrogen were also excreted. Very few candidates were able to offer a second excretory product along with urea in **(iii)**. Despite the carefully worded question a number of candidates gave water as one of their responses.

Both of the structures were poorly known in **(b)**. Many answers gave parts of the alimentary canal, although it was clearly indicated that the diagram was of the kidneys and associated structures. Not many recognised that structure **A** was a blood vessel, and of those who did, many thought it was a pulmonary vessel, the aorta or vena cava. Structure **B** was frequently confused with the ureter. It is important that ureter or urethra are spelt correctly as credit cannot be given for ambiguous responses.

Very few candidates gained full credit in **(c)**. Many responses dealt with removal of the amino acids via the alimentary canal as amino acids or as proteins and very occasionally as urea, with references to the rectum and faeces. Very few appreciated the role of the liver in the removal of excess amino acids. Some candidates wrongly thought that urea was formed in the kidneys.

Question 3

Although the fruits of the tomato and dandelion may have been unfamiliar to candidates, there was sufficient information in Fig. 3.1 for them to have made logical biological suggestions as to the means of dispersal, by animals in the former case and by the wind in the latter. In both cases, there were responses that simply relied on the fruits with their seeds dropping beside the parent plant and did not take account of the question referring to transportation away from the parent plant. This of course allows colonisation of new areas and reduces the risk of mass destruction by diseases or natural disasters when clustered together. Additionally, when spread out, there is less competition between seedlings and the parent, and between individual seedlings, for factors such as light, water and minerals. A significant number of responses confused dispersal of the seeds with methods of pollination and these candidates did not seem to realise that pollination has to occur well before seeds are formed.

Question 4

Most candidates recognised that gas **X** was nitrogen but a significant number suggested that it was either carbon monoxide or hydrogen.

In **(b)**, the majority of candidates did not appear to realise that the lungs do not completely empty of all the air when breathing and thus gave responses in **(i)** of 3.5 dm^3. They should have appreciated that the volume of air inhaled at each breath is shown by the rise from the lowest point to the highest point of the graph curve, 0.5 dm^3. Also, many did not check the scale of the "at rest" diagram and thus did not spot that this record of breathing was for 30 seconds. Either of the above errors made the candidate's task in **(iii)** and **(iv)** much more difficult. In the latter part, the candidate was expected to recognise that 5% of the oxygen within the volume of air inhaled remains within the body, and base their calculation on this.

In part **(c)**, many candidates interpreted the two graphs to identify that both the rate and depth of breathing increased during exercise. When candidates responded to parts **(ii)** and **(iii)** they often tried to cover both the changes in breathing rate and heart rate in each section instead of focussing on the relevant processes in each. It was expected that responses for **(ii)** would concentrate on the increased intake of oxygen into the lungs and hence the increased absorption of the oxygen into the blood and the value of this to increased respiration during exercise as well as the increased excretion of carbon dioxide. Similarly, in **(iii)**, candidates should have focused on the rise in heart rate and the value of this in delivering oxygen to the active muscles and the increased rate of removal of carbon dioxide from them. Too many responses started from the basis that exercise needs more energy or oxygen, but then failed to relate these needs to the increased rate and depth of breathing or to increased heart rate.

Question 5

In **(a)** most candidates recognised that without producers there is no food supply for herbivores, and subsequently for carnivores. However, very few developed the basic point that only producers can utilise energy from the environment and that in virtually all cases this is light energy incorporated through photosynthesis, during which light energy is converted to chemical energy within compounds such as carbohydrates and later within fats and proteins. It is this source of energy that maintains the food web. The majority identified two herbivores from the five possible responses, but there were a few who clearly confused herbivores with carnivores. In response to **(iii)**, many recognised that the frog was at trophic Level 3 and although there were wrong responses such as 'carnivore', a response of another member of the food web (such as 'mouse') showed a misunderstanding of the question. In **(iv)**, most candidates offered a correct food chain but despite the question limiting the components of the food chain to being part of the food web, there were examples of food chains including organisms that had nothing to do with the food web in Fig. 5.1.

In **(b)**, very many realised that the loss of the jaguars meant that the eagles had less competition for food and hence their population would increase, but some responses only dealt with either the availability of more food or the population rise, but not both points. There were a few answers based on the false concept that with the loss of the jaguars there would be less food for the sloths and howler monkeys, and thus their population would fall which would, in turn, cause a fall in the population of eagles.

A significant number of responses overlooked the fact that **(c)** was about the effect on humans of deforestation, and considered the effect on other members of the food web. Suggestions about the removal of human food sources and raw materials were logical ideas, as were references to the effects of erosion and possible flooding affecting humans.

Question 6

A small but significant number of candidates did not attempt to name one or both of the parts in **(a)**. Common errors were to suggest that **T** was the amnion or amniotic fluid, or even the vagina. The spelling of umbilical cord, **S**, was extremely varied. In **(ii)**, many candidates did not seem to appreciate that the main function of the placenta is the transfer of substances between the maternal and fetal blood systems and that this occurs mainly by diffusion. In order to gain credit, candidates needed to state precisely what is being transferred, e.g. oxygen, carbon dioxide, glucose, amino acids, etc. Vague terms such as 'food' did not gain credit. Part **(iii)** should have alerted candidates to the fact that blood does not flow between the mother and the fetus, yet many persisted with this idea in their responses to **(ii)**. Many candidates identified reasons for the two blood systems not being joined, but often did not extend their responses to offer a clear explanation.

In part **(b)** the majority of candidates deduced that child 1 would have normal haemoglobin.

In **(c)** the candidates' deduction of the three genotypes posed more of a problem. Most commonly, the genotype for child 2 was correctly identified, but those for the two parents were more commonly wrong than right.

Responses to part **(d)** often seemed illogical as candidates selected members of the family who had different genotypes based on their responses to **(c)**.

Question 7

In **(a)**, a small number of candidates spoilt their responses by trying to explain the processes that were occurring rather than simply naming them. Occasionally answers given for **3**, such as precipitation, suggested that candidates had not looked carefully enough at the labelling of the diagram.

The responses in **(b)** showed that many candidates could apply their knowledge to a new situation, and many spotted that the rainfall could lead to erosion leaving an unstable or thin layer of soil, or that the mineral salts in the soil could be dissolved and leached down into the river or sea.

Question 8

A significant number of candidates did not look closely enough at Fig. 8.1 and thus did not spot that label **A** was directed to the uppermost layer of the leaf, the cuticle. A response for label **B** of "mesophyll" was inadequate as there are two regions of mesophyll cells. Many responses in **(ii)** and **(iii)** were developed around incorrect answers in **(i)** and thus gained no credit. However, there were candidates who suggested that the cuticle's function was to absorb or reflect light. Responses which were based on the assumption that label **C** was either the guard cells or the stoma were equally acceptable. There was, however, a fairly common misconception that mineral salts pass in or out of the stomata.

In **(b)** many candidates identified 6 pm as the time of greatest water loss, but many misread the question and offered a period of time such as 2 pm to 6 pm or 6 pm to 10 pm. In the vast majority of responses the graph was completed accurately and the points joined as expected. There were a few who only joined the newly plotted points and did not link these to the two portions of printed points. In part **(iii)** the reverse of **(i)** occurred with very many candidates quoting a single time rather than a period of time. It was expected that candidates would quote the values where the newly plotted curve crossed the curve for mass of water lost. The actual values varied depending on the curve that candidates completed, but in most cases the crossing points were not read very accurately or were quoted without the suffixes (pm or am) being given. During the period 6 am to 2 pm the stomata would have been open and the factor that causes this would have been the light. Responses to **(b)(vi)** revealed misreading of the question. The vast majority of responses dealt with a factor, such as temperature, wind speed or humidity, which alters the rate of water loss. However, the question specifically requested reference to an increase in this rate and very few explained how a change in such a factor would actually result in an increase. Candidates were expected to relate this to changes in the diffusion gradient between the water vapour concentration within the air spaces inside the leaf and the atmosphere.

Question 9

Many candidates interpreted the data in the table correctly for part **(a)** and stated that the girl from Great Britain had more fat in her diet. Some supported their responses with data from the table. Many stated in **(b)** that having sugar and sweets in the diet directly caused diabetes, but this link is not really supported by scientific evidence. Many, however, correctly linked the presence of these items to the increased risk of tooth decay or to the risk of obesity. Most realised that the lack of protein can lead to impaired growth or development and some were familiar with the lack of protein as the cause of kwashiorkor.

BIOLOGY

Paper 0610/23
Core Theory

Key Message

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General comments

This year there were fewer candidates who did not attempt all parts of all questions. There did not appear to be a lack of time to complete the paper. However, there were candidates who showed very limited knowledge and understanding of some topics from the syllabus. Specifically, candidates seemed to have very limited knowledge and understanding of the role of the liver and kidney, the placenta and how environmental factors affect transpiration. Most candidates appeared to find the paper demanding in at least some of its aspects. Responses to various sections of questions revealed certain misconceptions and misunderstandings. There was evidence in a number of places, indicated in the comments on specific questions, that candidates had not read the questions carefully or thoroughly enough and thus their responses were inadequate or off the point. Candidates should be made aware of the need to read the questions thoroughly and to take note of each question's demands.

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Both of the structures were poorly known in **(b)**. Many labels were for parts of the alimentary canal although it was clearly indicated that the diagram was of the kidneys and associated structures. Not many recognised that structure **A** was a blood vessel and those who did realise it was a blood vessel regularly thought it was a pulmonary vessel, the aorta or vena cava. Structure **B** was regularly confused with the ureter. It is important that ureter or urethra are spelt correctly as credit cannot be given for ambiguous responses.

Very few candidates gained full credit in **(c)**. Many responses dealt with removal of the amino acids via the alimentary canal as amino acids or as proteins and very occasionally as urea, with references to the rectum and faeces. Very few appreciated the role of the liver in the removal of excess amino acids. Some candidates wrongly thought that urea was formed in the kidneys.

Question 3

Although the fruits of the tomato and dandelion may have been unfamiliar to candidates, there was sufficient information in Fig. 3.1 for them to have made logical biological suggestions as to the means of dispersal, by animals in the former case and by the wind in the latter. In both cases, there were responses that simply relied on the fruits with their seeds dropping beside the parent plant that did not take account of the question that referred to transportation away from the parent plant. This of course allows colonisation of new areas and reduces the risk of mass destruction by diseases or natural disasters when clustered together. Additionally, when spread out, there is less competition between seedlings and the parent and between individual seedlings, for factors such as light, water and minerals. There were a significant number of responses that confused dispersal of the seeds with methods of pollination and these candidates did not seem to realise that pollination has to occur well before seeds are formed.

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Most candidates did recognise that gas **X** was nitrogen but there were a significant number who suggested it was either carbon monoxide or hydrogen.

In **(b),** the majority of candidates did not appear to realise that the lungs do not completely empty of all the air when breathing and thus gave responses in **(i)** of 3.5 dm^3. They should have appreciated that the volume of air inhaled at each breath is shown by the rise from the lowest point to the highest point of the graph curve - 0.5 dm^3. Also, many did not check the scale of the "at rest" diagram and thus did not spot that this record of breathing was for 30 seconds. Either of the above errors made the candidate's task in **(iii)** and **(iv)** much more difficult. In the latter part, the candidate was expected to recognise that 5% of the oxygen within the volume of air inhaled remains within the body, and base their calculation on this.

In part **(c),** many candidates interpreted the two graphs to identify that both the rate and depth of breathing increased during exercise. When candidates responded to parts **(ii)** and **(iii),** they often tried to cover both the changes in breathing rate and heart rate in each section instead of focussing on the relevant processes in each. It was expected that responses for **(ii)** would concentrate on the increased intake into the lungs of oxygen and hence the increased absorption of the oxygen into the blood and the value of this to increased respiration during exercise as well as the increased excretion of carbon dioxide. Similarly, in **(iii),** candidates should have focused on the rise in heart rate and the value of this in delivering oxygen to the active muscles and the increased rate of removal of carbon dioxide from them. Too many responses started from the basis that exercise needs more energy or oxygen but then failed to relate these needs to the increased rate and depth of breathing or to increased heart rate.

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Most candidates in **(a)** recognised that without producers there is no food supply for herbivores and subsequently for carnivores. However, very few developed the basic point that only producers can utilise energy from the environment and that in virtually all cases this is light energy incorporated through photosynthesis during which light energy is converted to chemical energy within compounds such as carbohydrates and later within fats and proteins. It is this source of energy that maintains the food web. The majority identified two herbivores from the five possible responses but there were a few who clearly confused herbivores with carnivores. In response to **(iii),** many recognised that the frog was at trophic Level 3 and although there were wrong responses such as 'carnivore', a response of another member of the food web (such as 'mouse') showed a misunderstanding of the question. In **(iv),** most candidates offered a correct food chain but despite the question limiting the components of the food chain to being part of the food web, there were examples of food chains including organisms that had nothing to do with the food web in Fig. 5.1.

In **(b),** very many realised that the loss of the jaguars meant that the eagles had less competition for food and hence their population would increase but some responses only dealt with the availability of more food or the population rise but not both points. There were a few answers based on the false concept that with the loss of the jaguars there would be less food for the sloths and howler monkeys and thus their population would fall and this would cause a fall in the population of eagles.

A significant number of responses overlooked the fact that **(c)** was about the effect of deforestation on humans and considered the effect on other members of the food web. Suggestions about the removal of human food sources and raw materials were logical ideas as were references to the effects of erosion and possible flooding affecting humans.

Question 6

A small but significant number of responses were either totally blank or had no response for one of the labels. Common errors were to suggest that **T** was the amnion or amniotic fluid and even the vagina. The spelling of umbilical cord, **S**, was extremely varied. In **(ii),** many candidates did not seem to appreciate that the main function of the placenta is the transfer of substances between the maternal and fetal blood systems and that this occurs mainly by diffusion. Candidates needed to state precisely what is being transferred e.g. oxygen, carbon dioxide, glucose, amino acids etc. Vague terms such as food did not gain credit. Part **(iii)** should have alerted candidates to the fact that blood does not flow between the mother and the fetus yet many persisted with this idea in their responses to **(ii)**. Many candidates identified reasons for the two blood systems not being joined but often did not extend their responses to offer a clear explanation.

In part **(b)** the majority of candidates deduced that child 1 would have normal haemoglobin.

In **(c)** the candidates' deduction of the three genotypes posed more of a problem. Most commonly, the genotype for child 2 was correctly identified but those for the two parents were more commonly wrong than right.

Responses to part **(d)** often seemed illogical as candidates selected members of the family who had different genotypes based on their responses to **(c)**.

Question 7

In **(a),** a small number of candidates spoilt their responses by trying to explain the processes that were occurring rather than simply naming them. Occasionally responses for **3**, such as precipitation, suggested that candidates had not looked carefully enough at the labelling of the diagram.

The responses in **(b)** showed that many candidates could apply their knowledge to a new situation and many spotted that the rainfall could lead to erosion leaving an unstable or thin layer of soil or that the mineral salts in the soil could be dissolved and leached down into the river or sea.

Question 8

A significant number of candidates did not look closely at Fig. 8.1 and thus did not spot that label **A** was directed to the uppermost layer of the leaf, the cuticle. A response for label **B** of "mesophyll" was inadequate as there are two regions of mesophyll cells. Many responses in **(ii)** and **(iii)** were developed around wrong labels in **(i)** and thus gained no credit. However, there were candidates who suggested that the cuticle's function was to absorb or reflect light. Responses which were based on the assumption that label **C** was either the guard cells or the stoma were equally acceptable. There was however a fairly common misconception that mineral salts pass in or out of the stomata.

In **(b)** many candidates identified 6 pm as the time of greatest water loss but too many misread the question and offered a period of time such as 2 pm to 6 pm or 6 pm to 10 pm. In the vast majority of responses the graph was completed accurately and the points joined as expected. There were a few who for an unexplained reason only joined the newly plotted points and did not link these to the two portions of printed points. In part **(iii)** the reverse of **(i)** occurred with very many candidates quoting a single time rather than a period of time. It was expected that candidates would quote the values where the newly plotted curve crossed the curve for mass of water lost. The actual values varied depending on the curve that candidates completed but in most cases the crossing points were not read very accurately or were quoted without the suffixes (pm or am) being quoted. A correct response would have been in the range of 4.30 pm to 4.50 am. During the period 6 am to 2 pm the stomata would have been open and the factor that causes this would have been the light. Responses to **(b)(vi)** revealed misreading of the question. The vast majority of responses dealt with a factor, such as temperature, wind speed or humidity, which alters the rate of water loss. However, the question specifically requested reference to an increase in this rate and very few explained how a change in such a factor would actually result in an increase. Candidates were expected to relate this to changes in the diffusion gradient between the water vapour concentration within the air spaces inside the leaf and the atmosphere.

Question 9

Many candidates interpreted the data in the table correctly for part **(a)** and stated that the girl from Great Britain had more fat in her diet. Some supported their responses with data from the table. Many stated in **(b)** that having sugar and sweets in the diet directly caused diabetes but this link is not really supported by

scientific evidence. Many however correctly linked the presence of these items to the increased risk of tooth decay or to the risk of obesity. Most realised that the lack of protein can lead to impaired growth or development and some were familiar with the lack of protein as the cause of kwashiorkor.

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Extended Theory

Key Messages

1. Candidates must read the data provided in questions and use it appropriately to answer the question concerned. This was especially true for **Questions 2(a)**, **2(b)**, **4(e)** and **5(c)(i)**.
2. Candidates should use correct scientific terms in their answers, e.g. in **Question 2(e)**.
3. A description should not be repeated or relied upon solely when an explanation is required.
4. Although in most cases Examiners will credit phonetic but incorrect spellings for names of structures or processes, there are questions where a correct spelling is essential to avoid confusion with a similar term, such as mitosis rather than meiosis.
5. Candidates should be advised to pace themselves throughout the examination and to attempt every part of every question rather than leave blank spaces for which credit cannot be given.

General comments

In questions involving experimental methods, careful analysis of the information provided is required. Practice is needed in evaluating the information given and in critical thinking.

Comments on specific questions

Question 1

(a) Some candidates simply gave the labelled parts as answers, (which were all incorrect except for the eyes), rather than give features common to all arthropods, i.e. segmented body, jointed legs, eyes and exoskeleton.

(b) Most candidates scored at least some credit in this part. The skill of using a key was being tested, so no letters should have appeared in the grey boxes, the intermediate stages.

Question 2

(a) The explanation expected was that the blood had been through capillaries in an organ and had lost oxygen to that organ, or that oxygen had transferred from the blood to that organ. Use of the oxygen by the organ did not quite make the point on its own. If the organ was named, it had to be correct. Many candidates stated that the de-oxygenated blood would go to the lungs to be oxygenated, which did not answer the question.

(b) All the organs shown in the diagram would have been acceptable answers. 'Small intestine' was accepted as an alternative to duodenum or ileum. Colon and rectum were acceptable alternatives to 'large intestine'. A few candidates ignored the 'other than the spleen' instruction and wrote it in. Incorrect answers included kidney and bladder.

(c) The majority of candidates correctly identified the destination of the blood, (the liver), and many identified the absorbed nutrients as glucose, amino acids, vitamins and minerals. Some candidates lost credit by giving the 'transported from' location as 'intestines' only, rather than small intestines / duodenum / ileum / villi, and credit was lost for not identifying that point as the site of absorption. Almost no candidates mentioned that the substances being transported were in solution, were soluble, or were in the plasma.

(d) Most candidates took care to spell glycogen and glucagon correctly. Some described the glucose / glycogen conversions and the role of insulin and / or glucagon, but omitted to mention the

circumstances (high / low glucose concentration) that would lead to the conversions. Some candidates described protein as being deaminated rather than excess amino acids. Very few candidates mentioned the making of plasma proteins. Many candidates mentioned alcohol treatment in vague terms rather than specifically, i.e. broken down, respired or metabolised. Similarly, toxin treatment was frequently mentioned without actually naming one. A wide choice of toxins would have been acceptable responses, including just 'drugs'.

(e) This part was well answered. Candidates should avoid writing about phagocytes 'eating' or just 'trapping' pathogens; engulfing or ingesting was required. Very few candidates confused the roles of lymphocytes and phagocytes. Bacteria or pathogens were acceptable terms but 'foreign cells' was too vague to gain credit.

Question 3

(a) This part should have been straightforward for candidates, but many gained less than half of the available credit. In the first box, for which the answer was 'lowered', a clue could have been gained from the box above, i.e. the effect of the diaphragm muscles contracting was required. The third box to be completed was frequently filled in incorrectly, i.e. that pressure of the air in the lungs is increased. This was often followed by an incorrect response in the fourth box, with candidates stating that atmospheric pressure was lower than air pressure in the lungs. Again, clues could have been gained from the previous box in each case.

(b) Cell **A**, a goblet cell, did not require identifying by name, but the function of secreting or producing mucus was required. It should have been described as being sticky, and therefore trapping dust particles, bacteria, pollen grains, etc. Cell **B** had to be identified as cilia, which move or beat. Further credit was available for explaining that the cilia move mucus (regardless of whether or not it contains particles) in an appropriate direction such as away from alveoli. Many candidates did not mention that the cilia move, or stated that they move particles but neglected to mention mucus or a direction of movement.

Question 4

(a) This part was generally well answered, although a few candidates put the elements of glucose in the wrong order but were not penalised. Some candidates reduced the glucose formula to CH_2O or $C_3H_6O_3$. A number of candidates wrote a word equation, which would not have gained any credit.

(b) Some answers were difficult to read because of the way in which the numbers were written. It is suggested that, in order to avoid confusion, numbers are written as they are printed.

(c) (i) The idea of a constant light intensity was sought in this part; that it is kept constant, and that if it is changed, the rate of photosynthesis will also be changed. An answer that merely said that otherwise the results would be invalid did not gain any credit. This part was not well answered.

(ii) Most candidates recognised that oxygen, (which came from the plant due to photosynthesis), collected at the top of the syringe. It was less commonly noted that the pressure forced the water down the tube.

(d) The main error was omitting the units in the axis labels. Candidates could draw a straight line between each point or a curve beginning and ending at points. A slight overshoot was allowed at the top, but gaps, sagging between points, sketchiness and excessive line thickness was unacceptable.

(e) Candidates should have said that the rate of photosynthesis increases as the concentration of carbon dioxide, (not the concentration of sodium hydrogen carbonate), increases. Data quotes should have included units, but these were frequently omitted. Some potentially good answers did not gain credit due to omitting to say that above 0.07 mol per dm^3, carbon dioxide was not the limiting factor or giving an example of another factor that was.

Question 5

(a) Candidates should learn the genuine sources of methane such as cattle, land-fills, oil or gas extraction facilities, sewage works, etc. Animals and rubbish, unqualified, were too vague. Candidates should be aware that methane is flammable, is a useful fuel and is not a product of combustion as many appear to think.

(b) Candidates should learn the sequence of events for global warming / greenhouse effect and thus avoid losing credit for contradictions. Vague terms such as light and rays, instead of heat / IR / radiation did not score, and bringing CFCs and the ozone layer into the explanation showed that the issue had been confused with another environmental issue, which has been largely resolved.

(c) (i) The description of the sulfur emission changes should have been straightforward. Candidates could gain maximum credit for mentioning each obvious change or stage, getting the year references correct (an easy-to-read scale was provided) and putting the correct units in, in this case millions of tonnes of sulfur dioxide. This was essential to earn the credit that was available for quoting data.

(ii) This question on the effects of acid rain was well answered on the whole, but candidates needed to avoid vague descriptions of acid rain 'affecting the environment' and to make correct references to pH / acidity. Some candidates incorrectly associated an increase in pH with increased acidity. Candidates should be aware that aquatic organisms live in water, but marine organisms live only in the sea. Candidates should have said that acid rain damages limestone buildings or bronze statues; damage to limestone unqualified did not gain credit, as no harm would be done if just limestone outcrops or pavements were involved.

(iii) This part was fairly well answered but candidates should have referred to high- or low-sulfur fuels. Biodiesel was allowed as a low-sulfur fuel. References to alternative energy sources were credited, but not 'alternative' fuels, as these could refer to other high-sulfur fuels. Technological measures to clean emissions of sulfur were often described in vague terms; flue-gas desulfurisation, scrubbers, chimney electrostatic precipitators, etc. would have gained credit, but less precise terms would not. Methods of reducing demand for fuels (such as factory closures) did not gain credit, but methods of reducing demand for energy (car-sharing, cycling facilities, etc.) did.

Question 6

(a) This was well answered on the whole. Some self-pollination descriptions were too close to the term 'self-pollination' to serve as explanations. When writing about cross-pollination, many candidates used the word 'flower' in place of 'plant', altering the meaning of the answer and losing the credit which they would otherwise have gained.

(b) Candidates found this part difficult and most did not score highly. Common successful answers included: longer time taken; need for an agent of pollination; usual need for another plant; seeds being scattered to places where they cannot grow. Mention of pollen and energy waste, and variation leading to poorly-adapted plants was rare.

(c) Both answers had to be correct, with no contradiction, to score any credit.

(d) In completing the row for cross **4**, candidates had to cancel 2 : 2 down to 1 : 1 to gain credit. Some candidates could have written the numbers with more care and therefore avoided ambiguity. Overall there was a poor understanding of the expected phenotypes and ratios of offspring.

(e) Candidates found this part difficult. References to whether or not the phenotype is influenced by the environment were ignored in this part.

(f) This was reasonably well answered; candidates were able to recognise the advantage of colonisation of new areas and less competition. The point that was least-mentioned was that seed dispersal over a wide area allows breeding with a wider variety of plants, a bigger gene pool or more alleles. Greater biodiversity was not credited, nor were references to breeding with other species, which were frequently suggested.

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Extended Theory

Key messages

1. Candidates should always try to use correct terminology where possible. The use of the word 'affect' rarely gains credit, for example, comments that refer to 'A affecting B' tend not to gain credit as they are too vague.

2. Candidates should always be careful about answering questions that follow data in the form of graphs or tables. They should expect to describe and explain the data, but should always look for the command word for each part question and respond appropriately. Candidates on this paper did not gain credit in some part questions because they explained rather than described.

3. If candidates continue their answers onto blank pages or extra sheets then they should make it clear at the end of the answer lines where to find the continuation answer.

4. Incorrect answers should be crossed out clearly; candidates should not rewrite their answer over their original answer or in the space just above their first answer. It can be very difficult for Examiners to read answers rewritten in these ways. This is particularly important when candidates change one letter answers and edit their data quotes.

6. Candidates should read the instructions for each part question carefully and should not copy out the question before giving an answer.

7. Thick felt-tip pens that spread through the page should not be used.

General comments

Most candidates attempted all of the questions. The paper showed that some candidates have a wide and deep knowledge, whereas others struggle with some basic concepts. One of the main issues that some candidates have is with the English language and terminology. They often have the concept correct but do not communicate it well enough the gain the credit available. The use of the word 'immune' for resistance is a prime example. Even when candidates had the correct idea, it was not possible to award credit due to the contradictory or confusing manner in which some answers were written.

Comments on specific questions

Question 1

Knowledge of fungal adaptations from the supplement section of the syllabus was not very well known. In part **(b)**, many candidates did not appreciate that the question was asking about extracellular digestion, and just wrote about absorption instead. In part **(c)**, candidates were shown the results of an antibiotic sensitivity test. Some candidates used this term in their answers, but occasionally assumed it was the antibiotics that were sensitive to the bacteria rather than the other way around. Answers to **(c)(iii)** were often muddled as candidates did not always explain whether they were discussing completing the course of antibiotics or not completing it.

(a) A significant number of candidates did not know the name for the fungal body, often giving sporangium, spore or a word that closely resembled these. Some candidates gave the correct names but in the wrong order. The spelling of sporangium, hyphae and mycelium were rarely correct; 'hypae' was a common misspelling that was given credit as it could not be confused with

anything else. A large number of scripts included incorrect answers such as 'cell membrane', 'body' or 'projections'.

(b) Good candidates gave very detailed answers, often giving six or more of the points on the mark scheme. Candidates who gained some credit often explained that the fungus had to digest the nutrients in the agar, but gave little detail of how starch and protein are so digested. Many candidates followed the cue given in the question by the term 'absorbed', and wrote about that without explaining how starch and protein are first digested so glucose and amino acids can be absorbed.

(c) Many candidates explained in part **(i)** that the antibiotics killed bacteria so that they could not grow in the agar. Very few stated that the antibiotics diffuse through the agar. Part **(ii)** was less well answered, with few realising that the bacteria are resistant to antibiotics **1** and **5**. A common error was to state that the bacteria were 'immune' to the two antibiotics. Answers to part **(iii)** were often confused, but credit was often awarded for the ideas that not all bacteria are killed and that they would remain in the body to multiply, spread and cause illness again. Some candidates wrote about mutation and selection of antibiotic resistance.

Question 2

Answers to **(d)** showed some confusion; candidates often stated that bacteria are injected into the cattle treated with BST rather than the BST that has been prepared by bacteria in fermenters.

(a) Many candidates identified the organ and the two hormones successfully. The liver was a common mistake for the pancreas and glucagon was often spelt incorrectly. Fewer answers identified **C** as 'glycogen' than has been the case in the past.

(b) The liver was named by many candidates in answer to part **(i)**. Few candidates gained full credit in part **(ii)** for explaining the advantages of storing glycogen rather than glucose in cells. Many dealt with the control of blood glucose, but this rarely answered the question. The insoluble nature of glycogen was the first point made by good candidates who often explained that glucose is more reactive and likely to be used in respiration. A much smaller number explained that glucose would *decrease* the water potential of the cell so that water would be absorbed, possibly leading to bursting. Some realised that osmosis was involved, but did not make the consequence of storing glucose clear enough to gain credit. Some thought that glucose was too complex to store.

(c) This was the question omitted by the largest number of candidates. Of those who attempted an answer, few gave negative feedback. Common incorrect answers were homeostasis, osmoregulation and dialysis. A common error was to give one of the coordination systems – the endocrine system or the nervous system. Where these were followed by negative feedback they were awarded credit, since those two systems would be involved in the regulation of the blood glucose concentration.

(d) Some candidates wrote very confidently, in part **(i)**, about the process by which the gene for bovine somatotrophin would be removed from the cattle genome and inserted into a bacterium. There was some excellent knowledge shown of the details, including the roles of restriction endonucleases and ligases. These answers easily gained full credit. Some candidates realised that genetic engineering was involved, but simply gave the definition from the syllabus rather than explaining the steps involved. Answers that gained partial credit showed some understanding of the process although the role of plasmids was often omitted. Some candidates wrote at length about the use of genetically modified bacteria to produce BST in fermenters; these answers did not address the question. Answers to part **(ii)** were generally successful at giving advantages, as candidates explained that BST increases the yield of milk and meat so that fewer cattle are required. Disadvantages were less successful, although many candidates knew about the increased risks of mastitis however expressed.

Question 3

A number of candidates scored very highly on this question on plant biology. It should be noted that candidates taking this paper should use the term 'water potential' in the context of movement of water.

(a) There were many good explanations of the term *transpiration.* Most candidates gained credit by stating that water vapour passes out of stomata in the leaves. Few mentioned the evaporation of water from the surfaces of mesophyll cells within the leaf. Many wrote that water evaporates 'from the surface of the leaf' or 'from the stomata', neither of which are correct. The evaporation occurs inside the leaf.

(b) The absorption of water by root hairs was explained very well by many candidates, most of whom used the term *water potential* correctly in their answers. Some stated that water moves from the soil where there is a high water potential to the root hairs where there is a low water potential, but added 'therefore water moves down its concentration gradient into the root hair cells'. The Examiners ignored references to 'water concentration' if water potential was also used correctly. Some candidates assumed that uptake was by active transport and gave good detail of this process for which no credit could be awarded. Those who said that both osmosis and active transport were involved did not gain credit either. Many candidates who gained partial credit for this question omitted to state that water passes through a partially permeable membrane.

(c) There were many good answers to this question. Many referred to the spines which were variously described as spikes, needles or thorns. The reduction in surface area was linked to a reduction of water loss by transpiration. Some candidates stated that there were no leaves - a point that was also accepted. Other adaptations included the thick, fleshy stems for water storage and the use of spines to ward off potential grazers or other herbivores. Spines also provide shade and the ridged or grooved stem allows the stem to swell when water is available. The most common incorrect responses were a thick cuticle and long roots, neither of which was visible in the photographs. Each explanation had to be correctly linked to a description of a feature visible in the photographs in order to gain credit. Almost all candidates gave two complete answers.

(d) This question elicited some very well-reasoned answers that explained that plants that keep their stomata closed during the day and open at night lose less water, but cannot absorb carbon dioxide when it is required for photosynthesis. Some even stated that the saguaro stores carbon dioxide at night for use during the day. Some less successful answers stated that the plants photosynthesise at night, and many said that the plants do not photosynthesise and make no glucose, which was not credited, although answers that stated that plants carry out less photosynthesis and produce less glucose were accepted. Candidates who made these commonly made points rarely said that the rate of photosynthesis would be less than if the stomata opened during the day and closed at night, as is the more usual rhythm. Many candidates stated that the stomata allow water and sunlight to enter the plant. Others wrote about respiration, which in this question was not appropriate.

Question 4

There were some very good answers given to this question, and many clearly read the information carefully and followed the thread running through this question.

(a) There were many good answers that gave full definitions of the term *catalyst*, although some incorrectly stated that they are all enzymes or all proteins, which was ignored. Credit was often lost by candidates who wrote that catalysts 'do not take part in the reaction' when they meant to write that they are not changed at the end of the reaction. In the statement that catalysts are 'not affected by the reaction' was accepted as an equivalent statement.

(b) Many candidates realised in part **(i)** that temperature is a control variable (or controlled variable) in this investigation, but did not express the idea in those terms. Many stated that 30 °C is the optimum temperature for urease and this was accepted. Many also stated what might happen to urease if the temperature was higher or lower than this. Some did not gain credit because they stated that urease would be denatured at temperatures *lower* and higher than 30 °C. Most answers to part **(ii)** stated that test-tubes **5** and **6** were included as controls, but further explanation was often difficult, with some simply describing their contents. In part **(iii)**, many candidates identified suitable conclusions about urease that could be made from the results. Some gave their answers as lists which was perfectly acceptable. Many candidates did not gain credit here as they wrote a description of the results and did not make any conclusions.

(c) Answers to this question were variable, with some candidates giving specific points about conversion of ammonia to nitrate by nitrifying bacteria – the easiest way to gain full credit. Denitrification and nitrogen fixation were incorrect answers. Some candidates simply repeated the information given about the effect of ammonia on microorganisms in the soil.

(d) Most candidates gained full credit for their answers to part **(i)** by explaining that the stomach secretes hydrochloric acid which kills bacteria. In part **(ii)**, few candidates linked the neutralisation achieved by ammonia with its production catalysed by urease. In part **(iii)**, there was some confusion between the roles of lymphocytes and phagocytes, but on the whole there were many good answers.

Question 5

(a) In marking the description of the graph, the Examiners looked for comments and a data quote for changes in the total emissions and also for comments and a data quote for changes in emissions from the three fuels. There was a great deal of scope for candidates to choose appropriate comments to make, and many were successful. Answers that did not gain credit were those that *explained* the changes rather than describe them and those that were written in very general terms and did not give precise answers. Data quotes often did not have units or referred to tonnes rather than millions of tonnes. Candidates who looked carefully at the graph and read the scales accurately gained full credit.

(b) To gain full credit here, candidates needed to name the correct gas in each section: carbon dioxide for hydrocarbons and sulfur dioxide for compounds of sulfur. If these were correct, then the effects that these two gases have in the atmosphere were considered. Many candidates gained full credit by referring to carbon dioxide as a greenhouse gas and sulfur dioxide as forming acid rain. Carbon monoxide was not accepted as an appropriate response.

(c) This part was well answered, with many candidates stating that fossil fuels are non-renewable and need to be conserved for future generations.

Question 6

(a) Most candidates recognised that variation was a key point to make as an advantage of cross-pollination. Many went on to explain that the spread of pollen would lead to better dispersal and lack of competition, displaying some confusion with seed dispersal. Many assumed that the only form of cross-pollination is by insects, and completely omitted wind pollination. Candidates should have continued with the idea of variation increasing the chances of plants being adapted to changes in conditions and also allowing for evolution to take place. Many candidates struggled with expressing these ideas and often did not quite have the scientific language to gain credit.

(b) In part **(i)**, candidates found the identification of the structures in the carpel, **A** to **C**, and the seed, **D** and **E**, very difficult. Those who attempted this question were often successful at identifying the ovary wall, **A**, and the pollen tube, **B**, but the zygote, **C**, was often identified as the female gamete and it was rare to find the radicle and cotyledon, **D** and **E**, identified correctly. Credit was awarded if **D** or **E** was identified as the embryo. Many candidates gave mitosis as the answer to part **(ii)**, although there were some who gave meiosis, or answers that were a hybrid between the two such as 'metosis'.

(c) This proved to be a very hard question. Most candidates thought about sexual reproduction between animals here, thinking that all the seeds would only have two parents – the plant that produced the ovule and the plant that was the source of the pollen. However, in a plant that is cross-pollinated the pollen could come from several different male parents. Good candidates were able to gain credit here by explaining that meiosis is involved in the production of the gametes and some even went further to state that the gametes from the male and female parents would be different. Many, however, saw this in terms of a genetic cross between two parents and simply said that they could be homozygous or heterozygous, without giving some more detail. Some stated that different genes came from different plants. It is not that different genes come from different plants, but different alleles. Some candidates thought that the gametes had to come from different *species* to show variation.

(d) It was expected that candidates would write about the lack of conditions for germination and the lack of conditions for growth of the seedlings. Candidates rarely distinguished between these two stages of the life cycle, and credit was awarded for one or the other or both without requiring that the stage was identified as well. Candidates who did not gain much credit here often simply stated the conditions that are required for germination; this was not creditworthy. All the points on the mark scheme were seen and some candidates gave excellent answers. Common errors were to include a lack of carbon dioxide, which was not thought appropriate, and a lack of oxygen. The latter was only awarded if candidates stated that it is oxygen in the soil that is the important factor.

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Extended Theory

Key Messages

1. Candidates should always try to use correct terminology where possible. For example, the use of the word 'affect' rarely gains credit. For example, comments that refer to 'A affecting B' tend not to gain credit as they are too vague.

2. Candidates should always be careful about answering questions on data in the form of graphs or tables. They should always expect to describe and explain the data, but should always look for the command word for each part question and respond appropriately.

3. If candidates continue their answers onto blank pages or extra sheets then they should make it clear at the end of the answer lines where to find the continuation answer.

4. Incorrect answers should be crossed out clearly; candidates should not rewrite their answer over their original answer or in the small space just above their first answer. It can be very difficult for Examiners to read answers written in these ways. This is particularly important when candidates change one letter answers and edit their data quotes.

6. Candidates should read the instructions for each part question carefully and they should not copy out the question before giving an answer.

7. Thick felt-tip pens that spread through the page should not be used.

General comments

Most candidates attempted all of the questions. The Examiners saw a full range of responses with candidates giving all the points included in the mark scheme. There was no evidence that shortage of time was an issue. Few, if any, questions were omitted by significant numbers of candidates. Although no questions stood out as being inaccessible, very few candidates gained full credit on **Question 1 (e)**, **Question 2 (b)** and **Question 5 (b)** in which detailed knowledge of specific organs and processes were required.

Many candidates did not read questions carefully which lead to many candidates wasting time not answering the question at hand. Examples were **Question 2 (e)** and **Question 4 (c)** and **(d)**.

This is the first time that a paper has included a question on cladistics from ***Section I*** of the syllabus. Many candidates read the information carefully and analysed it well. Some, however, did not read carefully or did not realise how to use the information in Fig. 1.2.

Comments on specific questions

Question 1

This question used the speciation of cicadas to explore evolutionary relationships based on DNA evidence.

(a) This question asked candidates to state the features visible in Fig. 1.1 that showed the cicada is an insect. This was answered well. Common mistakes were 'jointed legs', 'segmented body' and 'exoskeleton'. Candidates must ensure that they give detailed and specific characteristics.

(b) Candidates answered this well identifying the group as the arthropods. 'Anthropod' was a common spelling error which was not credited.

(c) This was generally well answered with candidates commonly identifying chromosomes and/or nucleus as the precise location of DNA in a cell.

(d) Those candidates who used the numbers of the relevant species in their answers generally performed well in this question. Vague answers, without reference to the data, often did not achieve any marks. Some candidates thought that each branch represented an individual cicada rather than a species.

(e) This question was generally poorly answered. Many candidates seemed to have learnt a standard definition of natural selection but were not able to apply their knowledge appropriately. Sometimes biological terms were quoted haphazardly and it was apparent that candidates were unclear about the sequence of events. Weaker candidates seem to believe that individual organisms have great ability to adapt to a new environment by genetic changes.

Question 2

This question examined the structure and function of the kidney.

(a) Many thorough definitions of excretion were seen. A common mistake was to confuse egestion and the elimination of undigested food through the anus with excretion.

(b) Most candidates were unable to identify all the processes that occur in the kidney tubule with their location. There was no obvious pattern in the structures that were least well recognised.

(c) Approximately half the candidates knew the components of both the urine and filtrate.

Question 3

This question explored the process of producing mycoprotein via fermentation and its relevance as an alternative food source.

(a) Most candidates knew the name of the enzyme amylase in part **(i)**, although there were some who could not spell it correctly. Many failed to end their attempt with the letters '..ase'. The more able candidates were able to apply their knowledge of enzymes to the situation in part **(ii)** and answer this question confidently. Very few candidates realised that the fungus does not secrete amylase.

(b) Although the majority of the candidates realised the relevance of ensuring sterile conditions, a notable minority described the general need for optimal conditions, rather than the specific problems associated with contamination.

(c) Although most well-prepared candidates were able to focus their answer on the ecological importance of people eating plants rather than animals, those candidates who did not consider the biological significance of eating plant products over animal products did not perform well in this question.

(d) A wide variety of good suggestions were generally given in answer to this question. A common error was the idea that mycoprotein contains more protein and nutrients and that it can be stored.

(e) Only the more able candidates were able to recognise the limitations of mycoprotein as a food source. Few realised that its production is dependent on the production of corn starch and did not make relevant points as a result.

Question 4

This question considered weightlifting and running as physiological activities in relation to muscle movement and respiration.

(a) Common errors in this question were to add oxygen and water to the equation. Most candidates knew the formula for glucose, with the better prepared candidates confidently balancing the full equation correctly. There were many attempts at a word equation when the question specifically asked for a chemical equation.

(b) This question was answered correctly by most candidates, almost all of whom referred to the biceps contracting and the triceps relaxing. A minority had these the other way around and some even stated that both contract at the same time.

(c) A considerable number of candidates explained the reason for the shape of the graph, rather than to describe oxygen consumption. Although many candidates gave good detailed descriptions, common mistakes were to omit units or to use the wrong units (e.g. seconds, not minutes) in the answers.

(d) This was generally well answered with some candidates understanding why oxygen consumption does not return to resting levels immediately in considerable detail. Some of the weaker candidates referred to changes in heart rate rather than to changes in oxygen demand.

Question 5

This question examined the use of nitrogen fertilisers and the role of the nitrogen cycle in promoting crop yield.

(a) Very few candidates were able to perform the calculation in part **(i)** correctly. It was evident that some candidates did not have calculators with them. Although very few candidates achieved all the available marks for part **(ii)**, most were able to recognise the link between fertilisers and increased crop yield.

(b) Only the best prepared candidates were able to answer this question thoroughly. A common misconception was the role of decomposition and the confusion between nitrogen fixation and nitrification. Very few candidates described the role of deamination in breaking down excess amino acids to ammonia.

(c) The impact of the overuse of fertilisers on freshwater ecosystems was very well described. A common misunderstanding was the cause of the oxygen depletion in the water. Those candidates who described the impact on the atmosphere tended to write vague answers, suggesting global warming without any further explanation.

Question 6

This question examined the physiology and genetics of sickle cell anaemia.

(a) The role of haemoglobin and the mineral ion required to make haemoglobin were generally well known, with fewer candidates stating in **(ii)** that amino acids combine to make the protein structure.

(b) The features of sickle cell anaemia were well known. Common mistakes were to state that 'cells' were sickle-shaped, without specific reference to red blood cells, or to describe the haemoglobin molecule as sickle-shaped. References to 'immunity' to malaria were not credited.

(c) Some candidates knew the association between malaria and sickle cell anaemia, but a notable minority were unable to answer this question correctly.

(d) Most candidates gave the correct genetic diagram to show the inheritance pattern whereas they had more difficulty in expressing the same ideas in their written answers.

(e) Most candidates were able to answer this question on nuclear fallout in sufficient detail to achieve both marks. This was encouraging since questions on this topic have not been set on this paper for some time.

BIOLOGY

Paper 0610/04
Coursework

General Comments

In general, most Centres who entered candidates for Paper 4 were very well organised and prepared. However, a few new Centres had not understood the requirements for this paper, and had not provided their candidates with suitable, or enough tasks, to allow them to demonstrate their abilities in the four skills. It is very strongly recommended that any teacher wishing to enter candidates for this paper for the first time ensures that they have worked carefully through the training manual before doing so.

The majority of Centres had made excellent choices of tasks, each carefully designed to ensure that their candidates could demonstrate their abilities in each of the strands of each of the four skills. Almost all produce their own worksheets, rather than using 'off the shelf' published material. The latter can often provide good starting points, but are likely to need some modification in order to fully match the IGCSE criteria.

A very wide range of tasks were used to assess C1. The most successful of these involved the use of a range of standard scientific apparatus, and included some requirement for a small amount of decision-making by the candidate. It is important to provide some evidence to the External Moderator of how this skill has been assessed on each task, and most Centres did this in the form of a record sheet that they completed while they watched the candidates working. The record sheet generally took the form of a tick list with the candidates' names down one side, and columns in which each candidate's performance in each of several marking points could be recorded.

In Biology, C2 can involve observing and recording structures by means of diagrams and/or descriptions, and also using various instruments, such as thermometers, rulers, top pan balances, to make measurements or take readings that are then recorded in a results table. Centres are reminded that, if an outline or detailed results table is provided to the candidates, this limits the maximum mark that can be given. In order to be able to give a mark of 6, then no help must be given to the candidate in constructing and completing their own results table.

Good C3 tasks involve the processing of numerical results, which almost always involves drawing a line graph, histogram or bar chart. Once again, it is important to remember that providing any guidance about how to draw the graph will limit the maximum mark that can be given. If labelled axes are provided, then the maximum mark for this strand of C3 is 2. If the candidates are told what should go on each axis, then the maximum mark is 4. It is strongly recommended that candidates are provided with a sheet of good quality graph paper on which to draw their graphs, rather than trying to do so using lined paper. Points on a line graph should be very carefully plotted, using either a small cross or an encircled dot, so that the points are still clearly visible when the line is drawn. Lines should be constructed either by joining each point to the next using a ruler, or as best-fit lines. For the latter, candidates should ignore any clearly anomalous points, and make some reference to this in their evaluation or discussion.

The strand of C3 that is least well done is the recognition of sources of experimental error. Many candidates write instead about mistakes that they could have made, such as not taking a reading at the right time or not taking care to get their eye level with a meniscus when reading a volume. Candidates should be expected to comment on the most important sources of error in their experiment – that is, any intrinsic issues with the materials, apparatus or technique that reduce the trust that they can have in their results. It is a good idea to include these in the mark scheme. For example, it may be impossible to judge an end-point of a reaction precisely, or to keep an important variable absolutely constant. Candidates can only achieve a mark of 6 for C3 if they comment on the significant sources of error. This is not the same as suggesting how the experiment might be improved.

For C4, the best tasks provide candidates with a clear focus, asking them to investigate the effect of one variable on another. This can take the form of a question, a statement or a hypothesis. Note that there is no

requirement for candidates to write their own hypothesis. Candidates should be encouraged to identify the independent variable and the dependent variable, although there is no need to use this terminology, as this will then help them to recognise the variables that should be controlled. They should also be encouraged to make any necessary changes to their original plan once they begin to carry it out. It is generally much better to allow a candidate to proceed with a faulty plan, provided that it is safe, rather than correcting this for them. They will very often make improvements themselves, for which they can be credited.

It is most important to remember that all of the work that is used for assessment for Paper 4 must be a candidate's own, unaided work. For C1 and C2, this means that they should work alone. For C3, it is possible to work as a pair, or a group, or as a whole class, to collect and record results, but each candidate should then work individually to process the results, write a conclusion, and comment on sources of error. For C4, each candidate should work entirely alone to write their plan and carry out their experiment.

BIOLOGY

Paper 0610/51
Practical Test

Key Points

Candidates should be familiar with practical procedures as outlined in the syllabus in ***section 5.2***.

It is important to read questions carefully and, in particular, take special note of the command words. Notice especially, combinations of these command words such as describe and explain, and answer the questions appropriately.

In **Question 1** candidates should be able to follow carefully a sequence of instructions and use familiar, and unfamiliar, techniques to record observations and make deductions from them. They should be able to describe simple experiments, be able to handle experimental data appropriately and be able to modify and improve simple investigations. This includes identifying the sources of error.

Question 2 tests the observational skills of the candidates. These observations should enable candidates to make an accurate diagrammatic representation of a specimen and identify similarities and differences for the given specimens. It involves a variety of ways to handle experimental data. Candidates need to be able to use measurements to plot a graph and then describe and interpret these results.

General comments

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

In **Question 1,** many candidates were not familiar with suitable tests for gases. In **1(c)** and **1(d)** quite a number of candidates had not read the question carefully, nor had they looked at the number of marks available. As a result, those candidates who gave incomplete answers were unable to gain full credit for these questions. Although most candidates were able to describe and interpret the results given, some candidates did not fully understand the experimental procedure and, therefore, they found it difficult to identify appropriate errors in order to offer valid improvements in **1(e)**.

In **Question 2(a), c**andidates' diagrams were generally of a good standard. The diagrams were drawn adequately larger than the photograph. The leaf was in correct proportion and drawn using a single line for the outline shape and included correct details such as the veins. In **2(c)** candidates found it difficult to convert theoretical information into a practical situation.

In **2(e)(ii),** a line graph was required and most of the graphs drawn were accurate and of an appropriate size, filling more than half of the grid. There were, however, quite a number of candidates who constructed histograms and bar charts. All candidates need to learn how to choose the most suitable method of presenting the results.

Comments on specific questions

Question 1

(a) The candidates were asked to read through the questions and then carry out the experiment described. All candidates recorded six values for the number of bubbles counted. A few recorded 0 for all six and some recorded 0 for either **W1** or **W2.** There was not always a pattern to the results obtained for each yeast mixture. However **W2** always produced more bubbles than **W1.**

(b) (i) Most candidates correctly named respiration or fermentation as the metabolic process. 'Evaporation' was a common error.

(ii) The gas released, carbon dioxide, was slightly less well known and the common errors were oxygen and hydrogen.

(iii) Many candidates did not describe the correct test for carbon dioxide using lime which turns cloudy or hydrogen carbonate indicator which turns yellow. A small number of candidates did know that carbon dioxide is an acidic gas and used pH indicators but this is not specific and other gases would give a positive result for the presence of acid. Other candidates knew that carbon dioxide does not support combustion and suggested experiments where flames were extinguished but, again, this would not be specific for carbon dioxide. Quite a number of candidates suggested experiments involving soda lime which would absorb carbon dioxide but not test for the presence of carbon dioxide. Weaker candidates made suggestions which were in no way related to carbon dioxide e.g. using food test reagents. Those candidates who had identified the incorrect gas were given credit for a test which was appropriate for their gas.

(c) Candidates were asked to suggest why the test-tubes **W1** and **W2** were placed in warm water. All marking points were seen. However, it was usually only the more able candidates who gained full credit for giving more than one suggestion. Many candidates did know about the involvement of enzymes and that enzymes would work more efficiently in warm water. There were a number of references to enzymes being at their optimum temperature but it is incorrect to assume that all enzymes have an optimum temperature between 30 – 40 °C.

(d) Although candidates were asked to describe and explain any differences in the number of bubbles of gas released, a number of candidates were unable to gain full credit because their answers only described the differences and did not attempt to explain them. Most candidates correctly identified the two differences. Only the more able candidates fully understood the way in which the experiment was conducted and so were able to give relevant suggestions for any variations in the results. Very few candidates realised that the amount of yeast could have been different.

It is very important to read through the whole question before attempting an answer. Fig. 1.1 shows how the apparatus was to be set up to collect the bubbles from **W1**. It also shows test-tube **W2** standing in the warm water. The question states that after the three trials for **W1**, the whole procedure was repeated using test-tube **W2**. This means that test-tube **W2** would then be connected via a bung to the delivery tube in the same way as **W1** in order to collect bubbles that could be counted. Many candidates, however, did not read this or misinterpreted the experimental procedure. Some candidates thought that the bubbles from **W2** would be counted from the open tube. Consequently, incorrect explanations were given based on the ideas that **W1** was covered and **W2** was not or that **W1** had a delivery tube and **W2** did not. These ideas led to suggestions that bubbles would escape more freely from **W2** than **W1**. Another incorrect suggestion was that **W2** had no bung or it did not fit correctly and so had more oxygen available. This extra oxygen would result in a higher rate of respiration and more bubbles would be released. This was also inaccurate because the yeast was respiring anaerobically.

(e) Only a small number of more able candidates gained full credit here for two relevant sources of error and two linked improvements. Many candidates were able to identify one error although they did not always suggest an appropriate improvement. For the change in temperature, the most common mistake was to simply state that the error was the temperature alone and not that it could vary. Candidates often went on to suggest that the temperature should be kept constant but without describing any practical method for how it might be done such as using a water bath or adding more hot water at intervals. Very few candidates realised that although the same sucrose concentration was added to both and the volume of yeast mixture was the same, there could be a difference in the mass of yeast in the solution added. Inaccurate timing was quite a common correct idea and many realised that a stop watch would be more accurate than using a laboratory clock. The idea that the shaking of the tube could be a source of error was well understood with the most common improvement to not shake the tubes at all. Candidates did also realise that the counting of bubbles would lead to errors because some bubbles released could have been missed. Furthermore, the bubbles could have been different sizes and so result in an inaccurate measurement for the volume of gas released. Some candidates were familiar with the methods of collecting the gas by displacing water with an inverted container or using a syringe in order to measure, more accurately, the volume of gas released. Those candidates, who carried out the experiment wrongly, suggested errors and improvements linked to closing test-tube W2 with various materials and / or using a delivery tube for both W2 and W1. There were a number of incorrect references to lack of a control, not doing the experiment for long enough or not performing

enough trials. Many candidates simply suggested repeating the experiment without linking it to a particular error.

Question 2

(a) The lines used to draw the leaf were good, mainly single and clear. Those candidates who represented the serrated leaf edge as an additional jagged line outside a line representing the shape of the leaf lost credit because it resulted in a double line. On the other hand, too many candidates incorrectly represented the petiole with a single line. The petiole has a thickness and so should be shown with a double line and a closed end. The other common error was to include shading, in particular, for the petiole. There should be no shading in biological drawings.

The majority of candidates correctly made their drawing larger than half the page and with length and width in proportion.

Most candidates accurately represented the leaf showing sufficient detail, a midrib, petiole and veins each side of the midrib.

The most common correct label was for a vein but many incorrect, alternative labels for veins were seen e.g. vessels, canals, roots, capillaries. Overall, most candidates did not know the correct names for the parts of the leaf. The petiole was not well known, a small number of candidates were given credit for labelling it 'stalk' although 'leaf stalk' is more accurate. The most common error was for the petiole to be labelled the stem. Midrib, lamina and blade were not seen very often. A number of candidates lost credit for not labelling the leaf at all.

(b) (i) Candidates were asked to describe one similarity that could be observed in leaves **W3** and **W4**. This was quite well answered. The correct common parts identified were the veins and the leaf stalk.

(ii) Candidates were asked to describe two differences that could be observed. Errors arose from the fact that the candidates had not understood that **W3** and **W4** were each one leaf. Only a very small number of candidates were aware of the terms simple and compound leaves. The majority of candidates did not realise that **W4** was one leaf divided into leaflets and described it as many leaves on one stem. A small number of candidates did recognise that **W3** had a more pointed tip compared to **W4**.

(iii) Candidates were told that **W3** was from a dicotyledon. They were asked to give one visible feature to support this statement. There were many correct answers and 'network of veins' was the most common. Stating it was large was not enough. If large was qualified e.g. broad leaf or wide blade it was acceptable.

(c) (i) Candidates used a variety of approaches to position the lines to identify this cell, some as label lines and others as lines within the cell, either drawn vertically or horizontally. Overall, however, many candidates did correctly identify the photosynthetic cell. The common error was to choose, incorrectly, an epidermal cell.

(ii) It was expected that the candidate's final arrow would end on or within their labelled cell. This was often well done but in some cases the arrow did not go far enough and ended in an air space or neighbouring cell. Occasionally, the arrows ended in another photosynthetic cell some distance from the labelled cell. Most arrows from the outside correctly entered the leaf via a lower stoma although a small number were incorrectly shown entering through the cuticle on the upper epidermis.

(d) (i) The drawings in the table were clearly headed 'appearance of one leaf' and showed the gradual transition from an entire leaf to fragments of veins. This was not answered well. The most common error was to describe differences in mass of the leaf over the two years and make little or no reference to the appearance. Many of the candidates who did try to describe the changes did not know the names of the parts of the leaf and so were unable to gain credit for answers such as 'only a few sticks left' or 'only parts of the stem remain'. A number of candidates did give a reasonable description but then failed to explain the changes. The more able candidates did describe the changes and explained them in terms of the correct organisms involved in decaying the leaf. There were very few answers which referred to the relative toughness of the different parts of the leaf.

(ii) Using the measurements from **Table 2.1** candidates were asked to plot a graph to show how the mass of the leaf samples changed with time. A line graph is the most suitable as both variables are continuous with interval data. Some candidates drew bar charts or histograms. A bar chart shows the variation in a sample of repeated measurements with discrete categories and a histogram shows the variation in a sample of repeated measurements separated into classes or groups.

Overall, the graphs were well constructed.

Time should be on the x-axis and mass on the y-axis. The axes should be labelled with units 'time / months' and 'mass of leaves in sample / g'. The labels for the axes should be taken directly from the headings on the table of results but the abbreviation 'mass / g' was used by many candidates and credit was given. Quite a number of candidates did not label the axes fully, often omitting the units. The units must be shown.

The value for data must be evenly spaced on each axis so that the plotted points make full use of the whole of the printed grid. Candidates were required to use more than half of the available grid along both axes for their plots. Although most candidates did use an even scale, a small number used too small a scale on one or both axes.

The majority of candidates plotted the points accurately and only a small number of errors were seen.

Smooth free hand lines to form an accurate curve or ruled lines, both connecting all points were accepted. The majority of candidates did join all the points as expected. A small number of candidates extrapolated their lines beyond the data values. This is incorrect.

(iii) Most candidates were able to identify an initial increase in mass followed by a decrease in mass as time progressed. The more able candidates gave more details and referred to actual masses at particular times or calculated differences in mass for particular time periods.

(iv) Common correct answers were based around three ideas, temperature, water and number of decomposers. Environmental conditions that would not change the rate of decomposition were not accepted.

BIOLOGY

Paper 0610/52
Practical Test

Key Comments

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

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

Candidates should look out for combinations of the command words, such as describe and explain, and to answer these types of questions appropriately.

It is important that candidates use a good HB pencil for drawings and construction of graphs so that errors can be carefully and thoroughly erased.

General comments

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

Candidates did not appear to have time issues and most candidates completed the whole paper.

Questions were generally answered within the space provided; only extending to blank pages to continue if the candidate needed to make a second attempt.

In **Question 1** there was the need carry out a short investigation and to compare experimental data with data provided. Candidates were asked to evaluate the experimental design of the investigation and to compare the protein content of two samples.

Question 2 involved observational and drawing skills based on a specimen provided.

Question 3 tested data handling in a different manner with plotting data in graphical form and the opportunity to suggest a suitable control for the investigation.

Comments on specific questions

Question 1

(a) (i) and **(ii)** All candidates, apart from a very few, were able to follow instructions and recorded times that compared well with those that the Supervisor presented in the Report. Most candidates converted the times into seconds as required by the question.

(iii) This question on reliability required candidates to suggest and explain a reason for the use of three test runs. Common correct answers referred to the need for increased reliability expressed in a variety of ways. Few candidates explained why this was necessary. Most candidates referred to ideas based on mean / accuracy / fairness or confused reliability with precision.

(b) Candidates were required to describe and explain the results for the two types of milk. The first comment should be based on a comparison of the clotting time for both types of milk with credit for using manipulated data. The explanation for this comparative difference may vary based on the protein content available or the enzyme activity. Some candidates expressed the idea that the drying process may have an effect on the milk clotting time and the dilution may not give an equal concentration of protein.

(c) Although the overall investigation was based on the formation of clots of the soluble protein in both types of milk, the need to maintain a temperature, at which the enzyme would be active, was important. 40˚C is not the optimum; this was a common incorrect response. Neither was it selected to be the same as body temperature. The container of water was seldom referred to by candidates. They did not seem to equate this with the idea of a water bath. This question was poorly answered over all the candidate range.

(d) (i) and **(ii)** Only a small number of more able candidates gained full credit here for a source of error and a linked improvement. Many candidates were able to identify one error but they did not always suggest an appropriate improvement. Commonly mentioned sources included:- variation in milk protein; rotation rates changing; temperature of the water bath cooling during the test; inaccurate timing of end point; contamination of milk or apparatus.

(e) (i) and **(ii)** Most candidates were able to describe how to carry out the biuret test for protein and to describe the expected colour change for the presence of protein. The comparison of the protein content of the clots and the filtrate (whey) made this food test question more challenging as illustrated by the lack of comparison in answers from less able candidates. Details for one safety factor were often omitted in the description. A few candidates confused this test and incorrectly described the Benedict test for reducing sugar.

Question 2

(a) (i) On the whole, drawings were well constructed with clear, continuous outlines. The incidence of shading has decreased even though the top of the bulb could have led candidates to shade that area. Most of the drawings were sufficiently large and detailed. Many of the labels illustrated a lack of knowledge of the structure and role of a bulb, with labels naming examples associated with fruits or seeds.

(ii) Storage, reproduction or anchorage functions for the onion bulb were correctly noted in many answers. However, some candidates referred to the onion being used as a food or for medical purposes which are not functions 'for the plant'. Few candidates suggested two functions.

(b) Most candidates were familiar with iodine solution to test the tissues for the presence of starch. No colour change should be recorded if fresh iodine solution is used. It appeared that old solutions were used by some candidates as black particles were noted.

Question 3

(a) The idea that maggots used oxygen from the test tube and that the carbon dioxide released after respiration was absorbed by the soda lime, was understood by most candidates. However, only a few candidates extended this idea to refer to the reduction of pressure as the volume of gas decreased. A few candidates incorrectly thought that a vacuum was created.

(b) A line graph was required to present the sets of continuous data for the temperature in ˚C and the mean values of clotting time in seconds. A few candidates presented a histogram.

The axis labels must include the units of measurement but unfortunately these were not always shown. An even spaced scale was possible if the temperature started from 15˚C or if there was a foreshortening mark shown at the origin. As temperature is the independent variable and shown in the results table this should be plotted on the horizontal *x*-axis.

Some of the scales for time, chosen by candidates, were hard for them to interpret.

Points were plotted accurately, with the correct small indications such as 'x' or '+', by most candidates.

Lines drawn from point to point using a ruled line or a smooth curve were acceptable methods to show the effects. Few candidates constructed a line that was too thick and so obscured the plotting points. The use of the line of best fit must be shown carefully with a balance of the plotted points either side of the line, not in this case a line from the first to the last plot, as this showed a skewed line and omitted the slower respiratory rate after 35˚C. Some candidates incorrectly extended the line of the curves back to the origin or beyond the last plotted point for which there is no information.

(c) While the majority of candidates could give an overall description of the curve, it was necessary to refer to 35˚C peak, the changes 'up to' 35˚C and 'after' 35˚C. The question did not require an explanation, though many candidates often included one referring to enzymes and respiration rate, neither of which were relevant. A few candidates incorrectly mentioned that after 35˚C, the drop went 'backwards' instead of the coloured drop moving slower.

(d) It seems that many candidates are not aware of the purpose of a control in an investigation. Using no soda lime, no maggots or dead maggots were the most common correct answers. This would enable a comparison to be made with the live maggots in case there was a change in temperature or pressure in the apparatus due to changes in the environment. Some candidates incorrectly suggested leaving the clip open – this would prevent any changes occurring so no comparison could be made.

Many candidates failed to describe a suitable control; a controlled variable was mentioned instead e.g. the same number of maggots.

BIOLOGY

Paper 0610/53
Practical Test

Key Comments

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Points were plotted accurately, with the correct small indications such as 'x' or '+', by most candidates.

Lines drawn from point to point using a ruled line or a smooth curve were acceptable methods to show the effects. Few candidates constructed a line that was too thick and so obscured the plotting points. The use of the line of best fit must be shown carefully with a balance of the plotted points either side of the line, not in this case a line from the first to the last plot, as this showed a skewed line and omitted the slower respiratory rate after 35˚C. Some candidates incorrectly extended the line of the curves back to the origin or beyond the last plotted point for which there is no information.

(c) While the majority of candidates could give an overall description of the curve, it was necessary to refer to 35˚C peak, the changes 'up to' 35˚C and 'after' 35˚C. The question did not require an explanation, though many candidates often included one referring to enzymes and respiration rate, neither of which were relevant. A few candidates incorrectly mentioned that after 35˚C, the drop went 'backwards' instead of the coloured drop moving slower.

(d) It seems that many candidates are not aware of the purpose of a control in an investigation. Using no soda lime, no maggots or dead maggots were the most common correct answers. This would enable a comparison to be made with the live maggots in case there was a change in temperature or pressure in the apparatus due to changes in the environment. Some candidates incorrectly suggested leaving the clip open – this would prevent any changes occurring so no comparison could be made.

Many candidates failed to describe a suitable control; a controlled variable was mentioned instead e.g. the same number of maggots.

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Paper 0610/61
Alternative to Practical

Key Messages

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

The candidates need to read questions carefully and, in particular, take special note of the command words as outlined in the syllabus. Combinations of these command words, such as describe and explain, should be noted and the questions answered appropriately.

General comments

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

In **Question 1** many candidates were not familiar with suitable tests for gases. In **1(b)** and **1(c)** quite a number of candidates had not read the question carefully, nor had they looked at the credit available. As a result, those candidates gave incomplete answers and were unable to gain full credit for these questions. Although most candidates were able to describe and interpret the results given, some did not fully understand the experimental procedure and, therefore, found it difficult to identify appropriate errors in order to offer valid improvements in **1(d)**.

In **2(a)** the diagrams were generally of a good standard. The diagrams were drawn larger than the photograph, were in proportion and were drawn using a single line for the outline shape and details such as the veins.

In **2(d)** a number of candidates recorded inaccurate measurements for the cell diameter shown by the line **A-B.**

In **2(e)(ii)** a line graph was required; most of the graphs drawn were accurate and of an appropriate size, filling more than half of the grid. There were, however, quite a number of candidates who constructed histograms and bar charts. All candidates need to learn how to choose the most suitable method of presenting the results.

Comments on specific questions

Question 1

(a) (i) Most candidates correctly named respiration as the metabolic process. The common incorrect answers were evaporation and effervescence.

(ii) The gas released, carbon dioxide, was slightly less well known and the most common incorrect answers were oxygen and hydrogen.

(iii) Many candidates did not describe the correct test for carbon dioxide using lime water or hydrogencarbonate indicator. There were many different ideas. A small number of candidates knew that carbon dioxide is an acidic gas and used pH indicators, but this is not specific and other gases would give a positive result for the presence of acid. Other candidates knew that carbon dioxide does not support combustion and suggested experiments where flames were extinguished; again, this would not be specific for carbon dioxide. Quite a number of candidates suggested experiments involving soda lime which would absorb carbon dioxide, but not test for the presence of carbon dioxide. Weaker candidates made suggestions which were in no way related to carbon

dioxide, e.g. using food test reagents. Those candidates who had identified the incorrect gas were given credit for a test which was appropriate for their gas.

(b) All three marking points were seen. However, it was usually only the more able candidates who gained full credit for making more than one suggestion. Many candidates knew about the involvement of enzymes and that enzymes would work more efficiently in warm water. There were a number of references to enzymes being at their optimum temperature but it is incorrect to assume that all enzymes have an optimum temperature between 30–40 °C and this was irrelevant.

(c) A number of candidates were unable to gain full credit because their answers only described the differences and did not attempt to explain them. Most candidates correctly identified the two differences. Only the more able candidates fully understood the way in which the experiment was conducted and so were able to give relevant suggestions for any variations in the results, e.g. bubbles decreased through the trials because sucrose was used up or **W2** produced more bubbles than **W1** because it was left in warm water for longer. Very few candidates realised that the amount of yeast could have been different.

It is very important to read through the whole question before attempting an answer. **Fig. 1.1** shows how the apparatus would be set up to collect the bubbles from **W1.** It also shows test-tube **W2** standing in the warm water. The question states that after the three trials for **W1**, the whole procedure was repeated using test-tube **W2**. This means that test-tube **W2** would then be connected via a bung to the delivery tube in the same way as **W1** in order to collect bubbles that could be counted. Many candidates, however, did not read this or misinterpreted the experimental procedure. Some candidates thought that the bubbles from **W2** would be counted from the open tube. Consequently, incorrect explanations were given based on the ideas that **W1** was covered and **W2** was not, or that **W1** had a delivery tube and **W2** did not. These ideas led to suggestions that bubbles would escape more freely from **W2** than **W1**. Another incorrect suggestion was that **W2** had no bung and so had more oxygen available. This extra oxygen would result in a higher rate of respiration and more bubbles would be released. This was also inaccurate because the yeast was respiring anaerobically. A common error given to explain why the number of bubbles decreased as the trials progressed was that when the tubes were shaken the bubbles escaped.

(d) Only a small number of more able candidates gained full credit here for two relevant sources of error and two linked improvements. Many candidates were able to identify only one error so they did not always suggest an appropriate improvement. For the change in temperature, the most common mistake was to simply state that the error was the temperature alone and not that it could vary. Candidates often went on to suggest that the temperature should be kept constant but without describing any practical method for how it might be done such as using a water bath or adding more hot water at intervals. Very few candidates realised that although the same sucrose concentration was added to both and the volume of yeast mixture was the same, there could be a difference in the mass of yeast in the solution added. Inaccurate timing was quite a common correct idea and many realised that a stopwatch would be more accurate than using a laboratory clock. The idea that the shaking of the tube could be a source of error was well understood with the most common improvement being to not shake the tubes at all. Candidates also realised that the counting of bubbles would lead to errors because some bubbles released could have been missed. Furthermore, the bubbles could have been different sizes and so result in an inaccurate measurement for the volume of gas released. Some candidates were familiar with the methods of collecting the gas by displacing water with an inverted container or using a syringe in order to measure, more accurately, the volume of gas released. Those candidates who misunderstood how the experiment was carried out suggested errors and improvements linked to closing test-tube **W2** with various materials and / or using a delivery tube for both **W2** and **W1**. There were a number of incorrect references to lack of a control, not doing the experiment for long enough or not performing enough trials. Many candidates simply suggested repeating the experiment without linking it to a particular error.

Question 2

(a) Overall the leaves were well drawn. Credit was awarded was for the outline drawing. The lines used to draw the leaf were good, mainly single and clear. Those candidates who represented the serrated leaf edge as an additional jagged line outside a line representing the shape of the leaf lost some credit because it resulted in a double line. A significant number of candidates incorrectly represented the petiole with a single line. The petiole has a thickness and so should be shown with a double line and a closed end. The other common error was to include shading, in particular, for the petiole. There should be no shading in biological drawings.

The majority of candidates were awarded credit for their drawing being larger than the photograph and having the length and width in proportion.

Most candidates accurately represented the leaf showing a midrib, petiole and a minimum of five veins each side of the midrib, for which further credit was awarded. A small number of candidates did not draw enough veins.

The most common correct label was for a vein but many incorrect, alternative labels for veins were seen, e.g. vessels, canals, roots, capillaries. Overall, most candidates did not know the correct names for the parts of the leaf. The petiole was not well known; a small number of candidates were given credit for labelling it 'stalk' although 'leaf stalk' is more accurate. The most common error was for the petiole to be labelled the stem. Midrib, lamina and blade were not seen very often. A number of candidates did not read the question which instructed them to label the leaf.

(b) (i) This was quite well answered. The correct common parts identified were the veins and the leaf stalk.

(ii) Errors arose from the fact that the candidates had not understood that **W3** and **W4** were each **one** leaf. Only a very small number of candidates were aware of the terms simple and compound leaves. The majority of candidates did not realise that **W4** was one leaf divided into leaflets and described it as many leaves on one stem. A small number of candidates recognised that **W3** had a more pointed tip than **W4**.

(c) (i) Candidates used a variety of approaches to position the lines to identify this cell, some as label lines and others as lines within the cell, either drawn vertically or horizontally. Overall, however, many candidates correctly identified the photosynthetic cell. The most common error was to choose, incorrectly, an epidermal cell.

(ii) This was quite well done but in some cases the arrow did not go far enough and ended in an air space or neighbouring cell. Occasionally the arrows ended in another photosynthetic cell some distance from the labelled cell. Most arrows from the outside correctly entered the leaf via a lower stoma although a small number were incorrectly shown entering through the cuticle on the upper epidermis.

(d) Most measurements were accurate but a small number of candidates measured the vertical distance incorrectly. A common error was to give the measurement in cm rather than mm as instructed, and then not adjust the units in the answer. Many candidates accurately calculated the actual length. The most common error was to multiply by 280 rather than divide by it.

(e) (i) This was not answered well. The most common error was to describe differences in mass of the leaf over the two years and make little or no reference to the appearance. Many of the candidates who did try to describe the changes did not know the names of the parts of the leaf and so were unable to gain credit for answers such as 'only a few sticks left' or 'only parts of the stem remain'. A number of candidates gave a reasonable description, but then failed to explain the changes. The more able candidates did describe the changes and explained them in terms of the correct organisms involved in decaying the leaf. There were very few answers which referred to the relative toughness of the different parts of the leaf. A common error was to state that the colour / chlorophyll had disappeared first. This could not be determined from the information available.

(ii) A line graph was the most suitable here as both variables are continuous with interval data. Some candidates drew bar charts and histograms. A bar chart shows the variation in a sample of repeated measurements with discrete categories and a histogram shows the variation in a sample of repeated measurements separated into classes or groups.

Overall, the graphs were well constructed. Time should have been on the *x*-axis and mass on the *y*-axis. The axes should have been labelled with units 'time / months' and 'mass of leaves in sample / g' and the labels for the axes taken directly from the headings on the table of results, but credit was given for the abbreviation 'mass / g' which was used by many candidates. Quite a number of candidates did not label the axes fully, often omitting the units; the units must be included.

Candidates were required to use more than half of the available grid along both axes for their plots. Although most did use an even scale, a small number used too small a scale on one or both axes.

The majority of candidates plotted the points accurately and only a small number of errors were seen.

Smooth free-hand lines to form an accurate curve or ruled lines, both connecting all points, were accepted. The majority of candidates joined all the points as expected. A small number of candidates incorrectly extrapolated their lines beyond the data values.

(iii) Most candidates were able to identify an initial increase in mass followed by a decrease in mass as time progressed. The more able candidates gave more details and referred to actual masses at particular times or calculated differences in mass for particular time periods.

Question 3

(a) Two animals from **Fig. 3.2** that belong to the same invertebrate group as the animal shown in **Fig. 3.1** were expected to be selected, by letter alone. These two animals would possess recognisable features of the group. The animal in **Fig. 3.1** was a mollusc and most candidates correctly identified **A** and **C** as animals belonging to the same group.

(b) Animals **B** and **F** shown in **Fig. 3.2** both had elongated bodies, the absence of legs, the presence of eyes or scales. Many candidates correctly identified these similarities. Common errors were to refer to size, e.g. large when it clearly stated that the animals were not drawn to scale or to say that these animals were recognised as vertebrates which was not a visible feature.

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Alternative to Practical

Key messages

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

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

Candidates need to notice combinations of the command words, such as describe and explain, and to answer these types of questions appropriately.

It is important that candidates use a good HB pencil for drawings and construction of graphs, so that errors can be carefully and thoroughly erased leaving no trace.

General comments

Candidates did not appear to have time issues and most candidates completed the whole paper.

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

In **Question 1** there was the need to handle experimental data appropriately and to plot two data sets on the same axes. There was the requirement to be able to modify and improve simple investigations.

Question 2 involved observational and drawing skills as well as recognising cells in division and describing a food test.

Question 3 tested data handling in a different manner, observing and interpreting details from a graph to apply to questions on the plotted data.

Comments on specific questions

Question 1

(a) Almost all candidates were able to calculate the mean value correctly.

(b) (i) Few candidates included a key or means to distinguish between the two types of milk.

The axes labels must include the units of measurement but these were not always given. An even-spaced scale was possible if the temperature started from 30 °C or if there was a foreshortening mark shown at the origin. As temperature is the independent variable and shown in the results table, this should have been plotted on the horizontal *x*-axis. Many candidates chose a scale for the temperature from zero, so the plots were compressed and most of the grid was unused.

Most candidates chose a linear scale, but some provided two separate scales, one for the fresh milk and one for the dried milk. Some of the scales chosen for time were hard for the candidates to interpret.

Plotting the points was achieved quite well. Plot marks were sometimes too large, a small 'x' or '+' should have been used rather than some dots that entirely filled the whole of one small square.

A line drawn from point to point using either a ruled line or a smooth curve were correct methods to show the effects. Few candidates constructed a line that was too thick and obscured the plotting points. The use of the line of best fit must be shown carefully with a balance of the plotted points

either side of the line, not in this case a line from the first to the last plot, as this showed a skewed line. The line of best fit from the fresh milk was more difficult as the last point did not show an increase in the clotting time as 41°C. Some candidates wrongly extended the line of the curve back to the origin or beyond the last plotted point for which there was no data given.

As there were two sets of data to be shown and there was a possibility of the two curves crossing, different symbols should have been selected to distinguish each plotted point and these should then have been identified in a key to one side of the grid. Many candidates labelled the two lines with reference to the type of milk or to the table identifier, e.g. Table 1.1 versus Table 1.2. Several candidates failed to identify the lines.

Bar charts were presented by some of the candidates. These were presented neatly with well-constructed ruled lines, as separate columns for each type of milk, adjacent to each other or sometimes in a vertical manner with appropriate scale plots and key. However, these scored less credit than the more appropriate line graphs.

A few candidates incorrectly plotted all the three sets of individual readings for each milk type showing a complex image on the grid.

(b) (ii) The first comment should have been based on a positive correlation that the clotting time for both types of milk showed a decrease with a rise in temperature. The exception with the fresh milk was noted at the highest temperature of 41 °C. For those candidates who used a line of best fit this decline in the curve was frequently omitted. The comparison of the two types of milk was to be made and most candidates expressed this idea, although there was some confusion between the rate of clotting and the duration of the time period. It is important to support these ideas with reference to actual data; and also to refer to the units involved. The consideration of rate of clotting, as shown by the slope or gradient of the curves, was credited, but this was only made by the more able candidates.

(c) Common correct answers referred to the need for increased reliability expressed in a variety of ways. However, only the more able candidates explained why this was necessary. Most candidates referred to ideas based on mean / accuracy / fairness, or confused reliability with precision.

(d) This was poorly answered by all candidates. Although the overall investigation was based on the effect of temperature on the enzyme to promote the formation of clots of the soluble protein, there is a requirement that the temperature is controlled at each test. The idea that temperature was the independent variable seemed to confuse candidates and it was only the more able who appreciated this concept.

(e) Most candidates correctly identified the use of biuret reagent and the appropriate colour change. The comparison point for observing either the rate of colour change or the intensity of colour change was clearly made. The points missed by many candidates were not comparing a similar volume or mass of the two samples, or a suitable safety reference, e.g. eye protection such as goggles, or a laboratory coat.

Some chose inappropriate food tests for reducing sugar or starch.

Question 2

(a) (i) On the whole, drawings were well constructed with clear, continuous outlines. The incidence of shading has decreased, even though the top of the bulb could have led candidates to shade that area. Most of the drawings were sufficiently larger than the photograph to gain credit. However, credit was lost for lack of details, e.g. the two young shoots and the layers meeting at the top of the bulb. Many of the labels illustrated a lack of knowledge of the structure and role of a bulb, for example with labels for pericarp, cotyledon or plumules. Also, a large number of candidates incorrectly labelled roots as ‘root hairs’.

(ii) Storage, reproduction or anchorage functions for the onion bulb were noted in many answers. Some candidates referred to the onion being used as a food or for medical purposes which are not uses ‘for the plant’. Few candidates suggested two functions. The reference to roots in **(c)** led many candidates to suggest the function for roots, rather than the bulb, describing the uptake of water and / or minerals.

(b) Most candidates were familiar with the iodine solution as the reagent used to test the tissues for the presence of starch. It is important to refer to the iodine solution as iodine is a solid and insoluble in water.

(c) (i) Most candidates drew an appropriately sized circle around one correct cell. Very few candidates circled more than one cell although some only circled one half of a dividing cell.

(ii) Most candidates correctly named the type of cell division as mitosis, with the correct spelling. A few candidates named a stage of the mitotic division – anaphase when the chromosomes have just separated.

(d) Most candidates mentioned similar features in each row, but some did not, and described two non-contrasting features.

Question 3

(a) The idea that maggots used oxygen from the test-tube, and that the carbon dioxide released after respiration was absorbed by the soda lime, was understood by most candidates. However, only a few candidates extended this idea to refer to the reduction of pressure as the volume of gas decreased. A few candidates incorrectly thought that a vacuum was created.

(b) It seems that many candidates are not aware of the purpose of a control in an investigation. Common correct answers mentioned using no soda lime, no maggots or dead maggots. This would enable a comparison to be made with the live larvae in case there was a change in temperature or pressure in the apparatus due to changes in the environment. Some candidates incorrectly suggested leaving the clip open; this would prevent any changes occurring so no comparison could be made.

Many candidates failed to describe a suitable control; a controlled variable was mentioned instead, e.g. the same number of larvae.

(c) While the majority of candidates could give an overall description of the curve, it was necessary to refer to the 35 °C peak, the changes 'up to' 35 °C and 'after' 35 °C. The question did not require an explanation, although many candidates included one referring to enzymes and respiration rate, neither of which were relevant. A few candidates incorrectly mentioned that after 35 °C, the drop went 'backwards' rather than describing how slowly the coloured drop was moving.

(d) Most candidates answered by giving a description of the two distances for 20 °C and 30 °C, rather than an explanation. It required the link to be made to enzyme activity and respiration rate. The idea of 'doubling' was credited for comparison of the two distances. Where respiration was mentioned, it was often in only general terms without making reference to the maggots.

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Alternative to Practical

Key Messages

It is important that candidates frame their response bearing in mind the context of the question. Credit cannot be awarded for answers which are factually correct but which are not relevant.

General Comments

The majority of candidates performed very creditably on this paper, with relatively few gaining less than half the available credit. This indicates that candidates were both able and well taught. The standard of English was good and the work was well presented and legible. Nearly every candidate attempted all the questions and there was no evidence that timing had been a problem. As in previous examinations, some candidates would benefit by noting that if, for example, three marks are available, then three distinct points are needed in the answer. There were some areas where specific improvements could have been made and these will be clarified in the section on the relevant question.

Comments on Specific Questions

Question 1

(a) (i) An acceptable answer was either arthropoda / arthropod or crustacea / crustacean. Surprisingly few scored credit here, as the majority named one of the other three arthropod groups, and some opted for a mollusc or a type of worm.

(ii) Those who had given an incorrect arthropod group in **(i)** were allowed an error carried forward here. Few could state accurately two identifying features and many were confused about the number of legs, antennae and body sections present. This question discriminated well between the able and less able candidates. The responses here indicate that this is an area of the syllabus where practice may improve performance.

(b) (i) Almost all candidates gained full credit.

(ii) Slightly fewer candidates gained full credit here, the calculation of the mean causing more problems than the totalling.

(c) The less able candidates encountered a little difficulty, but overall, candidates performed well. Some candidates were not awarded credit for the key as only one part of the key was stated. A few candidates appeared unfamiliar with the pie-chart format, evidenced by the shading of alternate sections or by apparently random shading.

It would be helpful to markers in the future, if candidates used symbols on diagrams and charts, rather than colours. The latter can be difficult to distinguish in the black and white format that appears in on-line marking.

(d) This question proved to be a good discriminator between able and less able candidates. Able candidates gave answers that included points such as woodlice preferring damp conditions where they would not dehydrate, would be cooler, would find a source of food, would find shelter / protection from predators, and would be able to dig more easily. Some less able candidates identified dampness as a salient factor, but did not proceed with further information. Other less able candidates thought that some woodlice became adapted to the dry conditions.

There were also a few excellent descriptions of kinesis. This topic is not on the syllabus, but was given credit in this context.

(e) This was the question on the paper where candidates of all abilities gained the lowest credit, although the more able candidates performed more positively. When suggesting improvements to an investigation, it is essential that candidates first consider the design of the original. In this case the number of organisms used and the number of trials carried out were already adequate, so the frequently repeated answers of "use more woodlice" and "carry out more repeats" were not acceptable as improvements. Neither was "do it for longer", as five minutes was an adequate period of time in which to obtain a result.

Suggested improvements given credit were:

- use of subjects that were the same in some way, e.g. species, type, size, age, sex
- use of healthy or undamaged subjects
- keeping one of the possible variables the same, e.g. temperature, humidity levels, apparatus
- carrying out the investigations at the same time of day, so that activity levels are the same

Also considered valid suggestions were:

- using larger choice chambers (to prevent over-crowding)
- washing the choice chambers between trials (to remove traces of scent)
- using equal numbers of male and female subjects (to address possible disparity)

Some candidates gave suggestions that were not improvements to the original investigation, but which extended the investigation further by introducing other conditions such as dark and light, hot and cold and absence or presence of food.

Question 2

(a) There were many excellent drawings produced, with candidates across the ability ranges gaining full credit for producing diagrams that were drawn in pencil, were larger than the photograph, had no artistic shading and were accurate in terms of shape and proportion. A few diagrams were shaded, lacked a label, or were of stylised leaves.

As a general point for improvement, it should be noted that label lines need to end on the structure being labelled, and not merely point towards it.

(b) Many candidates performed both the measurement and calculation accurately. The most common error made was to multiply the measurement by 100, instead of dividing it by 100.

(c) This question presented candidates of all abilities with a challenge. The least able missed the point completely and referred to air spaces providing water supplies or reserves of gas. Many gave the correct connection between the air spaces and buoyancy in an aquatic environment, but did not develop the idea further. Further credit was gained by candidates who linked the floatation with a lower density, or who linked the idea with leaves on the surface being able to gain light and photosynthesise.

(d) (i) There were many possible answers here, but the most common ones given were: stopping light from reaching plants below the surface; competition for space and competition for minerals. Weaker candidates gave only one answer, or gave the same one twice using slightly different wording. There was some confusion over the causes of eutrophication, with a considerable number of candidates believing that the lack of oxygen arose from it being absorbed by the water hyacinths. There was also confusion over which processes (photosynthesis or respiration) were carried out at different times.

(ii) All ability ranges answered this more competently than **(i)**. The most frequently given responses were: limiting the growth by physical removal or the use of booms or nets; the introduction of a herbivore; the use of chemicals such as herbicides and pesticides. As candidates were given the information that the plant can reproduce vegetatively, suggestions of preventing the plant flowering, or of pruning the plants, were not accepted. Neither were impractical suggestions of moving the plants to cooler climates, or shading them from the light to prevent photosynthesis.

Question 3

(a) (i) Many excellent line graphs were produced, with candidates gaining full credit. Credit was lost for: irregular axes and axes that were incompletely labelled, incorrect plotting and extrapolated lines. Histograms were not awarded full credit. Some candidates plotted all three sets of data instead of the mean value.

(ii) Again there were some excellent answers across the ability ranges, with many candidates gaining full credit. Less able candidates tended to state what the result was at each individual temperature without coming to any conclusions. The main point for improvement is for candidates to quote figures from the graph in an instructive way.

(b) (i) The answers to this indicate that the distinction between accuracy and reliability was not appreciated. Many stated that repetition improved accuracy and expressed this idea in two different ways. Acceptable answers referred to reliability / consistency, identification / reduction of errors, checking on the method / technique or the possibility of variation in milk composition.

(ii) This proved to be a good discriminator between the ability ranges. Responses about the volume of milk used and the temperature of the trials were not credit-worthy as these are already covered in the explanation of the design. Milk concentration, type of milk used, volume of enzyme added, the pH of the reactants and method of mixing the milk and enzyme were all acceptable answers. More candidates gained credit for naming the variable than for the explanation. A reason of “it will affect the result” gained no credit as it was too vague. A precise reason was required such as “the addition of more enzyme solution to one trial would reduce the time taken to complete the reaction in that trial”.