BIOLOGY

Paper 0610/11
Multiple Choice

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

General comments

In general, candidates demonstrated considerable competence when answering questions on this paper.

Comments on individual questions

Question 8

Candidates were very sound in their knowledge of the sequence showing increasing complexity from cell to organ system. Only a very few were unable to place cell and tissue in the correct order, and this question proved to be the easiest on the paper.

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Question 9

This question demanded careful inspection of the diagram allied to a knowledge of the difference between plant and animal cells. The two plant cells were most frequently identified by their cell walls.

Question 23

Almost a quarter of the candidates thought that the blood flow at Z would 'remain constant'. Perhaps they saw it as being constant with that at Y, rather than as a result of vasoconstriction at X.

Question 24

There seemed to be some belief that, after a protein-containing meal, the urea levels in the blood leaving the liver, and in the urine could not both be high. It is appears to some extent to reflect the problems candidates have with their knowledge of nitrogenous excretion.

Question 25

It was, perhaps, a little surprising that almost a third of the candidates appeared to dismiss the response to gravity clearly shown by the seedling in Experiment 1. It may be that, since Experiment 2 had a stimulus (light) *added* to the second diagram, this led several of the weaker candidates to believe that this must be the answer and it may be a case of insufficient analysis of the information provided before selecting an answer.

Question 37

This was one of the very few questions on the paper where more candidates chose an incorrect answer rather than the correct one. It seems that they failed to appreciate that water is just as important as carbon dioxide as a requirement for photosynthesis, and that water, as well as carbon dioxide is released during respiration. It is likely that this was the result of a lack of careful thought rather than a lack of biological knowledge.

Question 38

The phases of a population growth curve are clearly not well understood. Candidates who performed well on the paper had no problems, but the rest, a clear majority, resorted to guesswork.

Question 40

It appears that the increase in concentration of pesticide in the tissues of successive organisms as it passes along a food chain is a fact with which many candidates were not comfortable. This led to wholesale guesswork, with all options being popular. A possibility is that the question was not carefully read, and candidates overlooked the fact that the answer needed them to identify the herbivore, not the carnivore at the end of the chain.

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Paper 0610/12
Multiple Choice

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

General comments

In general, candidates demonstrated considerable competence when answering questions on this paper.

Comments on individual questions

Question 5

Candidates were very sound in their knowledge of the sequence showing increasing complexity from cell to organ system. The only problem for a very few was to place cell and tissue in the correct order, nevertheless, the question proved one of the easiest on the paper.

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Question 9

This question demanded careful inspection of the diagram allied to a knowledge of the difference between plant and animal cells. The two plant cells were most frequently identified by their cell walls.

Question 12

First, candidates had to identify the fat molecule in the diagram and then appreciate that the product molecules had to be capable of being linked together to form the substrate fat molecule.

Question 15

Unfortunately, some candidates seemed to believe that vitamin D, rather than iron, is necessary for the carriage of oxygen in the blood.

Question 18

Not enough careful thought was put into the answering of this question. A significant number felt that the diffusion of carbon dioxide can only be out of the blood. Clearly they had allowed the diagram of an alveolus to cloud their minds to the diffusion of carbon dioxide from body cells into the blood. For that reason, this question rewarded the careful thinker.

Question 19

A rather alarming misunderstanding was exposed by this question, as a quarter of the candidates, forgetting, or not thinking about nitrogenous excretion through the kidneys, thought that nitrogen from proteins is present in exhaled air.

Question 26

There seemed to be some belief that, after a protein-containing meal, the urea levels in the blood leaving the liver, and in the urine could not both be high. It is appears to some extent to reflect the problems candidates had with **Question 19**, and highlights a weakness in the knowledge of nitrogenous excretion.

Question 37

This was one of the very few questions on the paper where more candidates chose an incorrect answer rather than the correct one. It seems that they failed to appreciate that water is just as important as carbon dioxide as a requirement for photosynthesis, and that water, as well as carbon dioxide is released during respiration. It is likely that this was the result of a lack of careful thought rather than of a lack of biological knowledge.

Question 39

It appears that the increase in concentration of pesticide in the tissues of successive organisms as it passes along a food chain is a fact with which many candidates were not comfortable. This led to wholesale guesswork, with all options being popular. A possibility is that the question was not carefully read, and candidates overlooked the fact that the answer needed them to identify the herbivore, not the carnivore at the end of the chain.

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Paper 0610/13
Multiple Choice

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

General comments

Candidates are to be congratulated on their performance on this paper which yielded very many impressive scores.

Comments on individual questions

Question 1

This was the easiest question on the paper, with clues given in the wording of the question as well as the diagram. The words ‘reacts’ and ‘digested’ in the question pointed to ‘sensitivity’ and ‘nutrition’. In the circumstances, the other option lacked plausibility, but the question served as a gentle introduction to the paper as a whole.

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Question 6

The possession of a cell wall as a feature unique to plant cells is well-known by almost all candidates.

Question 8

This question perhaps illustrated the importance of reading the question, and thinking carefully before answering. There was a tissue shown in the diagram, but the question asked about only one cell in that tissue. Almost a fifth of candidates, maybe hastily, opted for 'tissue' as an answer.

Question 15

It was clearly understood by most of the candidates that starch is digested in the buccal cavity, but there was much guessing by the weaker candidates over the second site of starch digestion.

Question 20

Candidates are often confused over whether there is a net use or release of energy during respiration. This may have been the cause of so many missing the fact that energy is required to build up protein molecules from their constituent amino acids.

Question 22

There seemed to be some belief that, after a protein-containing meal, the urea levels in the blood leaving the liver, and in the urine could not both be high. It appears to some extent to reflect the problems candidates have with their knowledge of nitrogenous excretion.

Question 32

As many candidates believed that meiosis occurs after gamete production, as correctly believed that it occurs beforehand. There may have been some difficulty in matching their knowledge to the stages shown in the diagram.

Question 33

Loosely encompassing the area of knowledge already exposed as unsound in **Question 20**, candidates again failed to make the link between respiration and energy loss, instead, opting in the main, for answers that exposed a serious misunderstanding - that energy is in some way recycled.

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Paper 0610/21

Core Theory

Key Messages

- Candidates should be made aware of the need to read each question thoroughly and to take note of the demands of each section before beginning their response.
- It should be noted that illegible work cannot be awarded credit.

General Comments

There were very few cases where candidates failed to attempt a whole 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. There was virtually no evidence that there were candidates who did not find the paper demanding in at least some of its aspects. There was evidence in a number of places, indicated in the comments on specific questions, that responses, though on the topic were inadequate or irrelevant. Candidates had difficulty in explaining phenomena and interpretation skills were lacking. Reading the instruction carefully is vital if the response is to fit the question. In a significant number of cases candidates' handwriting was very hard to interpret. Mistakes should be clearly crossed out and written again not over-written and very small writing also presents problems when the spelling of a term is crucial to the biology. In some cases responses were too vague to gain credit and in a few the candidates' poor language skills made it very difficult to work out what they were trying to convey.

Question 1

Most candidates were able to identify at least one other group of arthropods, although a surprising number thought molluscs belonged to this group. Usually the feature given as specific to the group chosen was the number of legs, although wings were accepted for insects. The presence of an exoskeleton is a feature of all the groups of arthropods as is having jointed legs and thus neither feature could gain credit. Most candidates used the information in the question in part **(b)** but many had difficulty in expressing their ideas clearly enough to gain both marks in each case.

Question 2

Few gained maximum credit in this question. Many candidates did not appreciate that differences were required in each case and just made statements involving no comparisons. The use of a comparative term, such as 'more' or 'less' was considered adequate. Numerical values were not required, neither were candidates required to give reasons for the differences, which some attempted to do.

Question 3

Most candidates recognised the components of the blood indicated and realised what they had to do to complete this section of the question. Some suggested structural features such as the presence of haemoglobin in the red blood cell, rather than a function for the cell, such as the transport of oxygen. A number of candidates thought that plasma formed antibodies rather than transporting them. In **(b)** some identified the missing component as platelets but knowledge and understanding of their role was poor.

Question 4

The majority of candidates completed the bar graph successfully but many either found the calculation in **(a)(ii)** too difficult, or did not understand what to do. Prostate cancer was usually identified correctly as occurring only in males although a number failed to read the question with sufficient care and suggested breast cancer for this response. In **(b)(i)** responses were sometimes too vague to gain credit. Knowledge of ways of reducing the risks of suffering from coronary heart disease was good, with many gaining credit here, Some spoilt their responses by giving general responses such as 'avoid junk foods', without explaining what

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they meant or with incomplete instructions such as 'don't drink'. In **(b)(ii)** references to alcohol needed to be qualified, such as 'drinking excessive alcohol' or 'addiction to alcohol'.

Question 5

In this question **(a)(i)** was meant to test the candidates ability to observe and compare two specimens, and most candidates completed this successfully. Many candidates identified the farming practice as selective breeding in **(a)(ii)** and candidates should have not offered responses such as 'genetic engineering' as they should have been aware that this is a recent development and has not been in use for hundreds of years. The candidates' knowledge of wind-pollinated flowers should have enabled them to complete **(b)** but a number made comments on flower colour or lack of scent, for which they had no evidence. It was expected that they would comment on the feathery stigmas and the anthers hanging out of the floral parts. In **(c)**, those candidates who correctly identified the chemical reaction usually also named the gases correctly, but a significant number thought anaerobic respiration was involved and then suggested that carbon dioxide was used up and oxygen produced. There was also a significant number of candidates who suggested that the reaction was photosynthesis and then commented in **(c)(iv)** about a lack of light. If candidates had noted the information about the temperature within the pit they should have realised that enzymes in the seeds would become denatured, thus killing living organisms, and so respiration would cease. They should have used this, together with deductions about changes in the gases in the pit, to respond to **(c)(iv)**. Part **(c)** was poorly answered overall, suggesting that some candidates cannot apply their knowledge and understanding in unfamiliar situations.

Question 6

Most candidates gained some credit in this question but relatively few gained maximum marks. Most knew that alleles were alternative forms of genes but a number thought that single sets of unpaired chromosomes were found in muscles. Many gained at least half of the marks available in this question.

Question 7

Most candidates managed to identify one of the arrows representing respiration but combustion was often confused with production of fossil fuels and photosynthesis, represented by C, was often misidentified. In **(a)(ii)**, references to global warming were often made but few were able to explain why this was a problem. In **(b)(i)**, most listed the four organisms in the correct order but the direction of the arrows representing the energy flow frequently suggested that it flowed away from the top carnivore, the oxpecker bird, to the grass. Candidates should be familiar with the convention used in food chains and food webs. Many candidates were unable to explain in scientific terms the difference between a chain and a cycle but many clearly realised that carbon dioxide produced in respiration was re-used, but energy, lost from a food chain, was of no further use to the living components of an ecosystem.

Question 8

A very large number of candidates appeared unaware of the mechanism for the inheritance of sex in humans Some allocated only one chromosome to each type of individual, and almost half of the candidates thought that a female inherited at least one Y chromosome. Many were also unable to complete the diagram accurately. Some allocated two chromosomes to each gamete, while others attempted to complete Punnet squares, in spite of the diagram provided, and their responses became very confused. This question was poorly answered and indicated little knowledge or understanding of this topic.

Question 9

In **(a)** most candidates revealed knowledge of the protein nature of enzymes, and also of their roles as catalysts. In **(b)** only about half choose the correct reagent, Benedict's solution, to show the presence of reducing sugars but many failed to warm the mixture or to give details of the colour change expected if the result was positive. This suggested they were unfamiliar with the practical test involved. In **(c)** most read the graph correctly but then failed to interpret it to describe how the changes in pH affected the activity of this enzyme. A significant number just expanded on the term optimum pH, rather than explaining how activity rose with increasing pH up to the optimum and then fell at higher pH levels as the enzyme became denatured. In **(d)** there was evidence of careless reading of the question as many described the action of saliva and others described swallowing but few described the role of teeth in breaking up large lumps of food into smaller particles to increase surface area for enzyme activity. Many candidates confused the action of the teeth with the molecular changes brought about by enzymes.

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Question 10

Most candidates gained credit in both sections of **(a)**, although a small number tried to put glucose or sugar on both sides of the equation. In **(b)**, knowledge of water uptake was often confused with transpiration. Few mentioned root hairs as the point of entry of water or osmosis as the mechanism involved. There were many who tried to describe the movement of the water after it had entered a plant and this indicated careless reading of the question. Basic biological knowledge appeared weak.

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Paper 0610/22

Core Theory

Key Messages

- Candidates should be made aware of the need to read the questions thoroughly and to take note of the demands of each question.

General Comments

This year there were more candidates who did not attempt all parts of all questions. However, this did not appear to be linked to a lack of time to complete the paper but rather to the inadequate preparation for the demands of the questions by many candidates. 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 photosynthesis, the structure of the heart, the genetic origin of the fruit casing and the embryo, germination and accommodation. There was virtually no evidence that there were candidates who did not find the paper demanding in at least some of its aspects. Responses to various sections of questions revealed again 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.

Comments on specific questions

Question 1

Although the majority of candidates referred to photosynthesis as being the mechanism by which plants formed their own food, many then defined it in terms of the processes that occur in respiration. Candidates should appreciate that starch is not the first carbohydrate formed in photosynthesis but is a later by-product of this process and is a storage form of carbohydrates in most plants. Candidates should also appreciate that starch is insoluble and must be converted back into a soluble material for movement around the plant and that the carbohydrate translocated in the phloem is sucrose. A number commented on the value of a storage product being insoluble and that plant storage organs could provide food materials during adverse conditions or after dormancy. Identifying the storage organs in **(c)** did not seem difficult for many candidates.

Question 2

In **(a),** far more candidates correctly identified vessel **A**, the aorta, than vessel **B**, the coronary artery. The question indicated that vessel **B** carried blood to the muscle of the heart wall and thus candidates should not have suggested it was a vein of any sort. Few candidates seemed to be aware that the walls of the left ventricle were more muscular than those of the right one and, of those who did know this, many suggested that this was because it received blood at a higher pressure rather than that it allowed the ventricle to create a higher pressure to force blood onwards away from the heart. In **(b)** many candidates explained how they could detect the pulse in a vein, not seeming to appreciate that a pulse only occurs in arteries. Many suggested that they would count the number of pulse beats in one second, a rather difficult and probably inaccurate method. There were a significant number of candidates whose responses dealt with counting breaths, measuring blood pressure and even using a thermometer.

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Question 3

There were many candidates who did not seem to note the phrase "rapid increase" in part **(a)(iii)** and thus did not link their response to the steepest part of the relevant graph curve. Also, a significant number of responses only quoted a single age and thus could not gain any credit. In **(b)(i)**, there was some confusion about which hormone was the relevant one in males while a considerable number of candidates offered the names of reproductive organs instead of naming hormones. In **(ii)**, despite the guidance in the question, many candidates chose to name reproductive organs or stated processes such as 'growing taller' or 'starting menstruation'. In response to **(c)** the commonest correct response was a reference to increased aggression or competitiveness.

Question 4

Some candidates did realise that the cells of the fruit pod would only have genes from that parent plant while those of the embryo in the seed would have a mix of genes from that plant and another plant that had contributed the pollen. However, they did seem to have difficulty in explaining this. A large number of responses suggested the difference was linked to the roles or positions of the relevant cells, such as 'the cells of the fruit pod are on the outside of the plant and are protective while those of the embryo are hidden inside the plant and are for reproduction'. There were some who thought that the embryo cells were haploid while those of the pod were diploid and seemed to think this answered the question. In **(b)**, few candidates were able to identify **A** and **B** as the plumule and radicle. Some named one of the structures as a cotyledon. Among the conditions needed for germination carbon dioxide, nitrogen and light were often listed. It is appreciated that light is a necessary factor for the germination of a few varieties of seeds, but the question did request conditions that were always needed. Candidates should realise that stating 'temperature' without any further qualification is inadequate as it will not be clear whether they are thinking of a suitable temperature. In **(c)**, defining 'development' proved to be a stumbling block for very many and candidates should appreciate that an increase in mass should refer to dry mass to define growth.

Question 5

The structure of the eyeball produced very mixed responses with some candidates naming the correct structures but linking the names to the wrong structures. The commonest errors were in mistaking the iris and thinking **D** was the sclera. Some candidates identified **B** as the aqueous humour and this was given credit. Structure **E** was often thought to be a blood vessel and an appropriate vascular function was stated in the response. Candidates should appreciate that the optic nerve carries nerve impulses to the brain and does not transfer images, pictures or 'messages' nor does it transfer information from the brain to the eye. Many explanations as to why **X** was the blind spot suggested that no light reached it or that if it was damaged the person became blind and very few understood that the region has no sensory cells that can detect light. Responses to **(b)** were very poor and revealed a very limited and often erroneous understanding of the roles of the three structures listed in the process of accommodation. Very often candidates described the role of the ciliary muscles as contracting to see the distant tree. Many candidates thought that the suspensory ligaments contracted and relaxed, like muscles, with some even referring to them as the suspensory muscles. Very few recognised that the change in shape of the lens was to become more curved or more convex and simply described the lens as becoming fatter without identifying that this was a change from front to back of the lens.

Question 6

Few candidates appreciated that it is the adipose tissue containing fat (**F**) that prevents most heat loss and that human body hair has a very limited effect on heat loss. **X** should have been identified as a hair and not as a hair cell, hair follicle, hair root or even a root hair cell.

Question 7

Few candidates seemed to understand that a food web shows the interrelationship of a number of food chains and that it shows the flow of energy through an ecosystem. In **(b)**, most candidates could identify the only omnivore in the food web and could also define the term 'carnivore', although in the latter case some stated that it only ate animals and plants! Part **(b)(iii)** presented some difficulty for candidates as they did not link the very small numbers of top carnivores to the limited amount of energy available at this end of any food web or chain. Many dealt with the fact that some, like the artic wolf, were hunted or that the climate and environment were unfavourable. Very many managed to offer logical explanations of the effect a sudden decrease in the lemming population would have on the populations of artic foxes and arctic hares. In the latter case, some developed their explanations around the need for the foxes to find alternative additional

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food while others followed on from their response in **(i)** of the falling numbers of foxes. Another alternative approach to **(ii)** was to link the fall in lemming numbers to an reduced demand for lichen and thus a greater availability of food for the hares. All logical approaches gained equal credit.

Question 8

Although the majority of candidates plotted line graphs there was a number who presented the data in the form of a bar chart and thus limited their ability to gain marks in parts **(a)** and **(b)(ii)**. Among those drawing line graphs there were a significant number who either reversed their scales, despite the two axes being labelled, or plotted values for the yield as the values given in the table in exactly the same sequence as in the table and with the points plotted equidistant apart. The former of these two major errors could be attributed to careless reading of the information already present and the latter to a very limited understanding of how to plot basic graphs. In **(b)(i)** many quoted the value as 4.8 overlooking the need to deduct the yield without the addition of any fertiliser to deduce the increase. In **(b)(iv)** although many calculated the effect of spreading the 100 kg of fertiliser over two fields they regularly overlooked, in the alternative calculation, the yield from the field not receiving any fertiliser. In part **(c)**, very few candidates linked the addition of nitrate fertiliser to its use in the formation of amino acids, the formation of protein from the amino acids and the role of protein in cells and crop productivity.

Question 9

The commonest chemical pollutants named were carbon dioxide, carbon monoxide and sulfur dioxide. However, few candidates linked this to the problems arising when vehicles burn fossil fuels, releasing pollutants in their exhaust fumes and that the ban in city centres was related to not adding to existing pollution levels. In **(b)**, few candidates recognised the increased risk of asthma attacks in severely polluted atmospheres. They overlooked the fact that young babies are regularly nearer to the level of exhaust pipes and thus are more exposed to exhaust fumes. Also a number of pollutants irritate airways and trigger coughing which can place an extra strain on the heart and lungs.

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Paper 0610/23
Core Theory

Key Messages

Candidates should be made aware of the need to read each question thoroughly before answering.

General comments

Almost all candidates attempted all parts of all questions, and their responses throughout suggested that they had adequate time to complete the examination. Some candidates showed very limited knowledge and understanding of some topics from the syllabus, particularly the antagonistic muscles, the route of sperm from the testes to the ovum, the effects of environmental conditions on transpiration and the interbreeding of plants. In some questions, there was evidence that candidates had not read the questions carefully or thoroughly enough.

Comments on specific questions

Question 1

The majority of candidates were able to link the definitions to the relevant characteristics, although a number linked the first definition in the table to nutrition instead of respiration.

Question 2

In part **(a)** most candidates identified the process as photosynthesis, but of these far fewer were able to identify the time at which the carbon dioxide concentration was at its lowest, and thus when most of the carbon dioxide had been removed by the pepper plants. The correct answer was the most frequently seen, but responses ranged between 06.00 hours and 23.00 hours. Few candidates were able to offer logical explanations as to why there was no electricity on day **M**. In part **(b)**, although the question asked for factors other than the availability of carbon dioxide and light, a significant number erroneously quoted one or both of these factors. A common misunderstanding in **(c)** was that a high sugar intake causes diabetes. High sugar levels increase the risk of a person developing diabetes, mainly because they tend to become overweight or even obese, but there is no causal link as yet identified.

Question 3

Many candidates correctly identified the two muscles, but a significant number seemed to think that **C**, the ligaments at the elbow joint, contracted and extended the arm at this joint. Candidates should appreciate that neither ligaments nor tendons can contract, although the former can be stretched. Understanding of the term *antagonistic muscles* was very poor and many responses showed a variety of misconceptions.

Question 4

In **(a)(i)** many candidates quoted similarities between the two gametes, but not ones related to their function. However, in **(ii)** most identified the presence or absence of the tail and linked this to the motility of the sperm. A significant number of candidates correctly identified **X** and **Y**. The most common errors were to identify **X** as a form of nuclear division and **Y** as either the fetus or embryo. In **(c)(ii)** the majority of candidates did not seem to understand the route taken by sperm from the testis to the oviduct. Details of the journey within the male system were regularly omitted and within the female system they were often limited to “the sperm in the vagina swims to the egg cell”. Many thought that the sperm enter and fuse within the ovary and the journey through the cervix and uterus were overlooked. Although in **(d)** few candidates had any difficulty in selecting the relevant nutrients, there were often rather vague or erroneous reasons given for why the nutrient was important.

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Question 5

In part **(a)**, most candidates linked the third imbalance to coronary heart disease or obesity, although these two effects were also linked to the other two imbalances. It was not uncommon for candidates to muddle the effects of the first two imbalances with one another. There were many vague responses in **(b)**, which simply suggested that unidentified technology improved crop production.

Question 6

A range of organs were suggested in **(a)(i)**, with the commonest incorrect one being the kidney. In **(a)(ii)** a significant number of candidates stated that alcohol reaches the brain via neurones. In part **(b)** candidates often muddled their explanations in **(i)** with descriptions in **(ii)**; many dealt with effects, such as cirrhosis of the liver and addiction that are not related to the dangers of driving a vehicle. In **(c)**, most did not seem to focus on social problems.

Question 7

In **(a)** a significant number of candidates gave names of consumers in response to **(i)** and many responses in **(ii)** named primary consumers. The completion of the food chain and the responses in **(iv)** revealed that many candidates did not understand that the arrows in such a food chain represent the movement of energy between organisms or trophic levels. Some suggested that they showed "who ate whom" but named the organisms in the wrong sequence for this to apply, such as the mahogany tree eating the forest mouse. Response to part **(b)** showed that many candidates were able to apply basic principles to the links shown in the food web, although a number of answers became rather muddled as they were developed. Some, however, suggested that if all the warblers were removed the local people would then catch tanagers and forest mice as an alternative source of pets. It was very common for candidates to complete Table 7.2 utilising the data in Table 7.1 in part **(c)** although there were some errors in addition. A significant number then used their information in Table 7.2 to construct a pyramid of numbers for only trophic levels 2 to 4, completely overlooking the need for trophic level 1. A significant proportion of those who did attempt to include this trophic level made it wider than that for the primary consumers as they failed to realise that Table 7.1 gave data for one mahogany tree only. In part **(d)** very few recognised that for a pyramid of biomass they would need information regarding the mass of each type of organism.

Question 8

The majority of candidates gained all of the available credit but there were some who gave "egestion" within their list of responses, often for **S**. Although "transpiration" was the best response for **R**, "evaporation" was also acceptable. In part **(b)** some candidates identified materials such as sweat, urine, exhaled air or faeces, while others named the relevant processes. There were some candidates who muddled urea with urine. Overall, responses to **(b)(ii)** were weak. A few followed a potential route via transpiration, condensation, rainfall and an animal drinking, but did not develop their response sufficiently for the water to reach the animal's cells. Others described the eating of plants by animals and the subsequent uptake of water from these food materials into the blood plasma and then into cells. Very many candidates misinterpreted the data in the table in part **(c)**, and gave as their responses to **(i)** one of the four letters, **A**, **B**, **C**, or **D**, although the shoots were clearly identified in the table as 1, 2 and 3. Despite this error, many did recognise that the number or size of the leaves could explain the differences in the results in each of the four sets of conditions. In the final part of **(c)**, many candidates seemed confused as to what effect the humidity of the air would have on the leaves and whether this would increase or decrease the movement of the bubble. A significant number thought the air humidity would have a direct effect on the water in the tube rather than via the leaves and transpiration.

Question 9

Candidates showed little knowledge and understanding in their responses to **(a)**. The basics of pollination were either not known or were thought irrelevant. Many of those who did make a sensible attempt to answer the question overlooked the need to interbreed between the two varieties. In **(b)** knowledge of the term *gene*, and where the genes are within a coffee plant cell, was poor. Many responses dealt with structures larger than cells. A larger number of candidates recognised the process described in **(c)** as mutation. Overall, the responses in **(d)**, **(e)** and **(f)** showed that the candidates were able to utilise the data in the tables and identify the relevant varieties.

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Paper 0610/31
Extended Theory

Key Messages

- Almost every question in this paper includes stimulus material, such as graphs, tables, photographs, diagrams, drawings or prose, much of which was unfamiliar to candidates. Those who gained most credit from data interpretation questions often annotated the tables or graphs provided as they read through the information. Annotating graphs and tables is a key examination technique in science and one that candidates should practise.

- Candidates should be able to give precise answers to data response questions and use correct scientific terminology. Words such as increase, decrease, peak, maximum, minimum, and optimum should be used to describe trends and patterns. Some candidates showed that they had a good command of this vocabulary. Vague terms rarely gain credit and hence words such as 'affect', 'effect' and 'change' should be avoided; for example, an answer that states that 'the rate of breathing changes' is unlikely to gain any credit.

- Data from tables and graphs should always be given with the appropriate units.

- Candidates should pay careful attention to the specific number of responses requested in a list. This rule also applies to questions where one answer is required.

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- Answers to questions that are continued in blank spaces or on additional paper must be identified clearly with the appropriate number and letter, e.g. **2(c)(i)**. Additionally, candidates should make reference to the continuation answers in the answer spaces provided for each question.

- Candidates should avoid writing initial answers in pencil and then overwriting in pen and should also not use thick felt tip pens as the ink run through can affect the clarity of the answer overleaf.

General Comments

Candidates are encouraged to attempt every question and to take note of the mark allocation as a guide to how many points are expected. Writing should be clear. Candidates should try to leave time to read through their answers and amend or add to them as necessary.

Comments on specific questions

Question 1

(a) Most candidates completed the table in the way intended with ticks and crosses. Only a few candidates left gaps in their answers. Most answered correctly, but a common error was to indicate that mammals have feathers.

(b) Cassowaries feed on fruits, but often the seeds are not digested. In answer to this question, it was expected that candidates would state that fruits are soft or seeds are hard, and that cassowaries do not have the enzymes to digest seeds or their testas. A common misconception was that the seeds are too big for the birds to swallow. Some candidates thought that the reason for not digesting seeds was that they had to be distributed undamaged.

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(c) Most candidates chose wind as a method of seed dispersal, but went on to describe adaptations for wind *pollination*. Few candidates explained how seeds are dispersed in the wind by reference to their adaptations for this method. Candidates who wrote about self-dispersal rarely named the method, but instead just gave a detail of a particular mechanism.

(d) Most candidates correctly identified three conditions required for germination. Most gave water, warmth and oxygen, but light and other methods of breaking dormancy were accepted as they are considered conditions for germination. However, 'hot' was not credited as an alternative to warmth and 'humidity' was not accepted as an alternative to water or moisture.

(e) The first expected answer was that cassowaries need a large area in which to live; the reverse argument was not accepted as it forms part of the question. Very few candidates went on to use the information from the beginning of the question that these birds are flightless and so cannot move easily from one small reserve area to another, nor did they mention the need for many trees to produce enough fruit, or the limited availability of nesting sites in small reserves.

Question 2

(a) (i) Most candidates stated correctly that a balanced diet must provide the appropriate nutrients in the right quantities. Very few went on to write about the provision of sufficient energy or materials for metabolism. Candidates should not attempt to define a term by using that term in their answer, for example by using the word 'balanced' to describe a balanced diet.

(ii) Most candidates gained full credit. 'Height' was not accepted, nor was just 'health' as an alternative to disease or a stated medical condition.

(b) (i) Most candidates drew the line indicating the renal threshold along the correct gridline on Fig. 2.1. It is good practice to add labels to lines drawn onto graphs; for example, some candidates put a **(i)** next to their line. Although in this case there was rarely any confusion with the answer to **(b)(iii)**, candidates should always be encouraged to do this if there are two or more lines on one set of axes.

(ii) The time period when glucose appeared in the urine was from 60 to 300 minutes or from one hour to five hours. 240 minutes and four hours were credited. Many candidates gave a particular time, such as 60 minutes, 150 minutes or 300 minutes rather than a period of time.

(iii) Many candidates gave no response. The dome-shaped line should have gone right across the graph. No credit was awarded for lines that stopped short of 330 minutes. Again, it was helpful if the line was labelled **(iii)**. Lines were mostly drawn, correctly, beneath the 180 line, but some were flat and gained no credit.

(c) Many candidates obtained full credit for their answers explaining how people who do not have diabetes control their blood glucose concentration. Some candidates mentioned insulin, but did not state that it is secreted, produced or released by the pancreas. Very few candidates stated that glucose is absorbed by cells in the liver or muscles. There were some references to the kidney excreting excess glucose as is the case for the diabetic in this question. Some candidates confused insulin with glucagon.

Question 3

(a) (i) Many candidates identified enzyme **1** in the flow chart in Fig. 3.1 as amylase. Among the incorrect answers were 'carbohydrates'. Carbohydrase was not accepted as that is too general a term.

(ii) In this question, some candidates wrote about the enzyme being 'killed' rather than denatured by an extreme pH, although less frequently than in some previous examinations. There were some vague answers that did not merit any credit. Use of the term *optimum* was the most common way to gain credit here.

(b) Few candidates used the information from the diagram to work out that protease could break down enzyme **2** if the pH was not adjusted to make the protease inactive. Most gave vague references to protease contaminating the process.

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(c) The suggestion that the enzyme can tolerate hot temperatures was not credited. The Examiners were looking for the idea that the enzyme is stable at high temperatures.

(d) The question was about the production of enzymes for use in washing powders. Many candidates wrote about how the enzymes in washing powders digest fat and protein stains on clothing. No credit was given to these answers. The Examiners were looking for details of the fermentation process and any information on the role of bacteria in producing the enzymes. Some bacteria secrete the enzymes so that they can be easily harvested from the fermenter; others do not secrete them and therefore the bacteria have to be crushed to extract the enzymes.

(e) Most candidates only gained partial credit, with many simply stating that pectinase would increase the quantity of juice produced. Better answers stated that the juice is clearer and sweeter as pectins are broken down to sugars. Very few candidates wrote of the pectin being digested. A common error was to state that extraction of the juice was 'easier' without explaining how this is achieved.

Question 4

(a) Some candidates described the effects of sickle cell anaemia in absolute terms rather than in relative terms. They stated that no oxygen or carbon dioxide would be transported in the blood, rather than stating that there would be less oxygen or carbon dioxide carried. Candidates wrote about blood vessels being blocked by the red blood cells, but did not gain credit unless they stated that these blocked vessels are capillaries.

(b) (i) Many stated that the name for the alternative forms of a gene is *allele*.

(ii) When completing the genetic diagram, some candidates forgot that gametes are haploid and put two alleles in each of the circles provided. However, the Examiners ignored whatever error had occurred in adding the gametes when marking the child's genotype. As many candidates gave the correct genotype, H^SH^S, it was surprising that some did not use some back-reasoning to make their gametes haploid, rather than diploid.

(iii) Many gave the correct probability (0.25 or 25%). Where ratios (3:1) were given as well, they were ignored, so candidates gained the credit for the correct probability.

(c) (i) Few candidates gave satisfactory answers to this question. Successful explanations were structured around the three genotypes, H^AH^A, H^SH^S and H^AH^S. The key point is that people who are heterozygous, H^AH^S, have a resistance to malaria. Other points develop from this. In many cases, candidates thought that sickle cell anaemia is an infection that can be passed from person to person and did not make the link with malaria at all. Candidates should be aware that the H^S allele confers resistance to malaria, not immunity.

(ii) Very few satisfactory answers were given. Many referred to the quality of health services in the areas compared to other malaria-infested areas. The Examiners accepted any sensible suggestions, such as the idea that malaria may have only recently spread to these areas and that strains of malaria that do exist are not as severe as those elsewhere. Another line of argument is that the mutation has not occurred in people who live in these areas, or that in the distant past people who migrated to Indonesia and northern Australia did not have the mutation. The frequency of the allele, H^S, is very low in Indonesia. It is thought that it was introduced into the population in colonial times by troops from West Africa.

Question 5

(a) Many candidates completed the table correctly, but some ignored the column heading for sense organ, thus losing all the credit available. The mouth does not count as a sense organ, and 'heat' was not accepted for temperature. 'Sight' was sometimes given instead of light as a stimulus.

(b) (i) In explaining the term *involuntary action*, most candidates wrote about not having to think, use the brain or make decisions, but few stated that it is a response to a stimulus.

(ii) Care with structuring the answer was the key to success in this question. Candidates who followed the sequence of structures in Fig. 5.1 tended to gain credit by beginning with the receptor and ending with contraction of the biceps to give the response. Many candidates referred incorrectly to

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'messages' and 'signals' instead of electrical or nerve impulses. Candidates often did not make any distinction between the receptor and the sensory neurone. Even if the receptor is simply the nerve ending, the term *receptor* should still be used in the answer.

(iii) Many candidates gained full credit for describing the advantages of simple reflexes.

(c) Most candidates mentioned hormones in their answers, but some did not expand upon this to state that they travel in the blood or stimulate target organs.

Question 6

(a) Parts **(i)**, **(ii)** and **(iii)** were answered correctly by many candidates. Many chose proteins or amino acids for their nitrogen-containing compound. Part **(iv)** was more challenging as few identified process **F** as nitrification or oxidation.

(b) Most candidates gained credit for using their answer to part **(a)(i)** to state that nitrogen is required to make important molecules, such as amino acids and proteins. Some went further to state that these molecules are required for growth and repair. A few candidates stated that atmospheric nitrogen is in short supply, when what they meant is that fixed nitrogen in all its forms is in short supply.

(c) Most candidates explained the rarity of *Cassia mimosoides* in terms of it growing in an unsuitable habitat with unfavourable growing conditions. They stated that the climate is too dry and the soil provides few minerals. A few candidates spotted that there is an arrow between *C. mimosoides* and impala indicating that impala prefer to eat it. Similarly, there were few who used the information provided to suggest that *C. mimosoides* does not compete well with grasses.

(d) Most candidates obtained some credit for explaining why there are far fewer cheetah than impala. The reference to the numbers should have prompted answers that dealt with energy flow in food chains, but few explored this central idea in ecology. Full explanations were rare, although some candidates stated that local people might kill cheetahs to protect their livestock, or that not all the impalas would be eaten.

(e) Most candidates gained partial credit for explaining that all the organisms in an ecosystem are interdependent. This point was made in a variety of ways, some by stating that the loss of one species may lead to the extinction of another. The other points about the dependence on plants, eating a variety of foods, conservation of habitat, maintaining biodiversity and conserving natural ecosystems for future generations were seen rarely. These are important concepts. Some candidates simply repeated the information in the question.

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Paper 0610/32
Extended Theory

Key messages

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- Candidates should avoid writing initial answers in pencil and then overwriting in pen and should also not use thick felt tip pens as the ink run through can affect the clarity of the answer overleaf.

General comments

Most candidates attempted every question, with many of them able to give clear, well-written responses. Some capable candidates appeared to run out of time as they did not respond to questions that previous answers suggested they would have been able to answer. A few candidates had problems with English grammar. Longer answers, such as those in **Questions 2(b)** and **3(a)(iii)**, were generally well structured.

A number of capable candidates had problems expressing their ideas in some of the more difficult questions. For example in **Question 1(d)**, many candidates gave vague answers about zebra mussels competing with other species, but failed to explain for which resources they were competing. Protection is often an answer to a question such as **Question 1(c)**. Candidates should always state from what it is that an organism is protected. For example, very few candidates stated that the shell provides protection from predators.

Even though the Examiners make allowances for poor spelling, it is important that candidates learn the correct spelling of those scientific words that can be confused with others. Common spelling mistakes were 'cons' for cones in **Question 2(a)(i)** and 'mitosis' in **Question 5(b)(ii)** where many wrote meiosis or a hybrid of the two words. Other candidates failed to use scientific words, e.g. 'extinction', in **Question 1(d)** and 'photosynthesis' in **Question 4(c)**, although their answers did show that they understood the concepts.

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Question 2(a)(ii) was often misinterpreted. Many candidates wrote in correct detail about the action of radial and circular muscles in the iris bringing about changes in the diameter of the pupils, but did not mention the control of these reflexes by the nervous system. A common mistake in answers to **Question 4(d)** was references to the 'production' of energy in respiration. This incorrect statement appeared in other answers on this paper as well. Candidates should state that energy is released or transferred, not 'produced'.

Question 6(c) was surprisingly poorly answered. Many candidates stated that the Soay sheep 'adapted' to fit the environment as if adaptation is something the individual sheep can make happen. There was also much confusion with artificial selection even though the stimulus material made it clear that humans have not lived on the island of St. Kilda for 80 years. It was disappointing to see that few candidates started their explanation of natural selection by writing about variation within the population of sheep.

Comments on specific questions

Question 1

(a) Candidates gave a variety of features shown by all molluscs. Some of the examples given were features shown only by some groups of mollusc. The most common features that were accepted in answer to this question were: unsegmented, (muscular) foot and soft body. Although many molluscs have shells, which are sometimes referred to as exoskeletons, this is not a feature shared by all.

(b) Candidates often referred to the arms of the octopus by a variety of terms, such as 'legs', which were accepted; the suckers, its eyes and the absence of a shell were other correct answers. Some said that the octopus has no foot, but this was ignored as the arms are derived from the foot. Many candidates referred to 'feet' rather than arms; again this was ignored.

(c) Many candidates gave one adaptation of the mussel, but it was rare to find two correct suggestions. Most identified the threads visible in Fig. 1.1 as being responsible for the attachment of the animal to the rock. Other features that were accepted were the muscular foot and a sticky secretion, however described. Many candidates stated that the shell is an adaptation to survive when exposed to air, but often gave vague, inappropriate or incomplete answers, such as 'the shell protects the animal', 'the shell protects the animal from the air' and 'the shell protects the animal from hard-hitting waves'. Better answers explained that the shell reduces or prevents water loss from the animal when the tide goes out.

(d) The reference to food webs within the information supplied about the zebra mussel was a clue that candidates could refer to effects of this introduction on the organisms at different trophic levels within the community. Many candidates tended to have one idea, such as competition for food, but often without making it clear that the food was other living organisms; they often did not elaborate on this idea or think of two other effects. Very few gave any named trophic levels, but simply mentioned population changes in other organisms.

(e) Most candidates did not understand the reference to chemical analysis in this question. Many thought that this type of analysis meant adding large quantities of chemicals to rivers which might kill, or otherwise harm, organisms in the river. They did not realise that small samples of water are removed from the river and tested for the presence of chemicals so that this method has no effect on the organisms. Many candidates stated correctly that any pollution is likely to harm the mussels so that there are fewer of them or none at all. There were many answers stating that counting mussels is an easier or cheaper method than using chemical analysis, but these were not credited.

(f) This question was generally well answered. Pollution by non-biodegradable plastics is a serious environmental issue and many candidates considered the effects that these plastics have on animals that mistake them for food and/or become entangled in them. Others thought that the plastics might cover the surface of bodies of water reducing the light available for photosynthesis and this response was credited. Many gave the idea of reducing light, but did not make a link with photosynthesis. A few candidates failed to apply this problem to aquatic environments and described the build-up of plastics on land and the problems of disposal, such as using up space in landfill sites and the air pollution caused when these plastics are burnt.

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Question 2

(a) (i) Many candidates gave imprecise answers particularly when naming the effector. Many gave both circular and radial muscles, but very few stated that it is muscle *in the iris* which is the effector in the reflex shown in Fig. 2.1. The response to the stimulus is a decrease in the size, or diameter, of the pupil. Many stated that the pupil 'contracts' rather than 'constricts'; many also wrote that the pupil 'dilates and constricts' or that it just changes. Some were confused with other reflexes, for example the focussing reflex, as they named the ciliary muscle as the effector.

(ii) There were many good answers describing how the nervous system coordinates the response. Some candidates gave very thorough accounts of the antagonistic action of the radial and circular muscles in the iris, but rarely, if ever, referred to the nerve cells involved. Better answers stated that nerve impulses are 'sent' by receptors in the retina along sensory neurones to the brain. They continued by stating that the impulses reach the muscles in the iris along motor neurones. Many missed this and simply stated that impulses are 'sent to the muscle' without identifying the neurones involved. Some candidates confused this reflex pathway with that of accommodation and referred to ciliary muscles, while others gave accounts of a typical spinal reflex. Terms such as 'signals' and 'messages', which were often used for electrical impulses, were ignored and not given credit as equivalent to electrical impulses, but they did not preclude full credit being awarded.

(b) There were some excellent answers to this question. Many candidates stated that adrenaline increases the heart rate and the breathing rate and then discussed the supply of oxygen to the muscles. Vasodilation in muscles and vasoconstriction in skin and/or gut were described. In this sort of question it is important to explain that these responses to adrenaline increase the supply of oxygen to *muscles*. Many candidates missed this idea and stated that 'oxygen is sent to muscles' implying that the muscles did not receive any before the adrenaline was secreted. Many wrote about 'the body' here rather than to specific areas, such as the muscles and the brain. Few candidates referred to an increase in *aerobic* respiration and many stated that 'more energy is produced' rather than stating that more energy is released by the increase in the rate of respiration. Many candidates remembered the role of adrenaline in increasing the glucose concentration in the blood. Credit was lost where candidates stated that 'the heartbeat increases' rather than that 'the heart rate increases'.

(c) Many candidates gained partial credit here by giving one way in which involuntary actions differ from voluntary actions. Typical answers stated that 'involuntary actions do not involve making a decision, but for voluntary actions decisions have to be taken'. There were many variations on this point, including the vague answer 'involuntary responses are not controlled'. This type of answer was not credited unless further qualified. It was rare to find candidates referring to the speed of the responses or stating that involuntary responses are always the same. Perhaps triggered by the pupil reflex earlier in the question, some candidates stated that involuntary responses are protective, which was a creditworthy point.

Question 3

(a) (i) Many candidates stated that sterilising milk kills any bacteria or other microorganisms already in the milk. Few elaborated on this idea to gain full credit. Suitable answers involved competition between bacteria in the milk and the two species of bacteria added to make the yoghurt. Some candidates stated that bacteria in the milk might be pathogens, an idea which gained credit. Many candidates stated that sterilising 'removes' the bacteria from the milk or 'removes impurities'; neither of which were accepted. Many answers stated that sterilising would 'get rid of' rather than 'kill' the bacteria, supported by vague reasons, such as 'these bacteria will interfere with the process'. Many also stated that sterilising the milk 'gets rid of impurities' or 'changes the pH'.

(ii) Most candidates identified 45 °C as the optimum temperature, although few went on to explain that this is suitable for bacterial growth or reproduction. Many did, however, refer to enzymes in their answer and so gained full credit here.

(iii) Candidates who realised that this part was asking them to describe the exponential growth curve from ***Section IV*** of the syllabus tended to perform well here. The stages, lag, log, stationary and death, attracted credit as did any correct references to limiting factors, such as food, nutrients and oxygen. Many explained that the decrease in pH as the yoghurt is made gives a condition in which it is difficult for the bacteria to grow. A small number of candidates gave excellent descriptions of the roles of the two named bacteria in the yoghurt-making process and gained full credit. Few

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gave a full account, however, and only gained credit for reference to the decrease in population as a result of the accumulation of the acid products. A large number just concentrated on the death phase.

(iv) This proved to be a testing question. Many, however, did gain credit for using the information provided at the top of the question to explain that the two bacteria carry out different processes, or make different products, and explained that the two bacteria are interdependent.

(b) There were many answers that gave three suitable types of food additive. Common answers were preservatives, colourings, sweeteners and flavourings. Answers that were not credited included fruit, chocolate and nuts and any form of nutrient, such as sugar. Named additives, such as MSG and tartrazine, were ignored so if they were given as examples this did not preclude Examiners awarding full credit if the types of additives were given as well.

Question 4

(a) In completing the table, common errors were to put phloem and xylem the wrong way round and to give 'leaf' as the sink for the phloem (column **D**). Many candidates gave all four correct answers, but there were many blank responses for the sinks, or answers that showed that candidates did not understand the term.

(b) Amino acids was the most common accepted answer. The Examiners also accepted hormones, although they were given very rarely. Common incorrect answers were glucose, starch, protein, fructose, sugar and sap.

(c) Carbon dioxide was the clue in this question that candidates should start their answers with photosynthesis. Some missed this completely and often began by stating that starch is converted into sucrose. Candidates who gave the word equation or the balanced chemical equation for photosynthesis often gained credit if they included light energy in their answers. It was noticeable that quite a number omitted any reference to light. A common misconception was that sucrose is a product of photosynthesis. Better answers stated that glucose was converted to sucrose and some candidates even stated that it is formed from fructose and glucose. Quite a few seemed to confuse synthesis, or 'building up', with 'breaking down' and wrote 'glucose is broken down to sucrose', which was not accepted.

(d) The uses of sucrose proved to be a challenging question. Many simply wrote 'energy' and 'growth' without any further detail. Others stated that sucrose is converted into starch, but did not make it clear that this is for storage. Other answers that Examiners looked for were making nectar to attract or reward pollinators, and sugar in fruits to attract animals for seed dispersal. Many candidates only gave partial answers, such as 'making nectar' or 'for storage'.

(e) This question on absorption of ions attracted many good answers that gained full credit. There were good explanations of the uptake of phosphate by active transport. Less successful responses dealt with diffusion into root hairs or osmosis, instead of active uptake. Answers from weaker candidates revealed some confusion between active transport, diffusion, osmosis and gradients. If candidates identified active transport, then the answers generally tended to gain full credit. If not, then credit could only be given for identifying root hair cells as the site of absorption. Many missed out on the points about uptake but referred to transport in the xylem.

Question 5

(a) There were many good answers to this question. Some candidates, who stated that there is a halving of the chromosome number, then went on to write about restoring the diploid number at fertilisation which was not necessary to gain the credit. Unfortunately, some candidates did not state that the number of chromosomes is halved in meiosis and wrote 'so that the full chromosome number is restored at fertilisation' as one of their answers for which credit was not awarded.

(b) (i) Question omitted.

(ii) There were many very good answers to this part, although some were difficult to follow, but usually attracted full credit for statements about the single zygote formed at fertilisation and its division into two cells. Answers did not always state that the cells separate after they have divided, but comments such as 'two foetuses develop' made that clear.

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(c) This was poorly answered by many candidates who gave definitions of growth, rather than development. The most common response seen was increase in dry mass and numbers of cells. A smaller number rewrote the introduction to the question. To gain credit, candidates had to state that during development there is an increase in complexity as a result of cell specialisation. Candidates also gained credit if they implied that the body becomes more complex with the growth of tissues, organs or limbs.

(d) There were many correct responses to this question. Common errors were to give male genotypes as the second and/or third answer.

(e) This proved to be a difficult question for many. Candidates missed the obvious answer that a mutation had occurred in the gene for the blood clotting protein. Most candidates who gained some credit here wrote about the mother being a carrier, but rarely developed the idea very well. A large number explained this in terms of an autosomal recessive condition rather than a sex linked recessive. Many candidates seemed not to realise that it was sex linked and answered in terms of both parents being carriers. It was concerning that many candidates gave an explanation stating that haemophilia is a sexually transmitted disease. One or two referred to transmission of the disorder in blood transfusions.

Question 6

(a) Candidates tended to use the photograph of the Soay sheep to identify at least one phenotypic feature. The most common were presence or absence of horns and the colour or patterning of the coat. Less successful were the attempts to explain the term variation in phenotype, with many using the word 'variation' in their answers. There was a lot of comparison with modern sheep breeds instead of variation within the population on St. Kilda. Very few responses used correct language for the description of phenotype. Some candidates concentrated their answers on continuous and discontinuous variation. Citing one feature, e.g. have horns, did not explain the phrase phenotypic variation. Quite a number of answers included unnecessary information on 'survival of the fittest'.

(b) (i) Most candidates realised that they had to base their answer on a comparison of the two charts in Fig. 6.2. They often stated that the overall number of deaths was higher in the years with high populations, but rarely stated that for all sizes of lambs more died than survived. There were a few data comparisons, but candidates who gave them often lost the credit because they were either numerically inaccurate, or not within the Examiners' tolerance range, or they did not compare the same weight category in the two populations. Some candidates were vague when using data, using terms such as 'over 100 sheep died'. Errors here were to write about changes in population from year to year. There is no data in Fig. 6.2 about this aspect of the sheep population on St. Kilda. A number of candidates thought that the changes in population size were as a result of people slaughtering the sheep for food.

(ii) Success here depended on how well the candidates had answered part **(i)**. If this had been muddled, they were unlikely to give a clear answer here. Explanations tended to concentrate on competition between the sheep for food. Rarely were answers developed to explain the consequences of this competition that would lead to a higher death rate. Some candidates referred incorrectly to increased predation or to the fact that lambs were eating each other. Very rarely, there was a reference to number of lambs per female. A common error here confused size of population with size of sheep and some answered in terms of the differences in sheep size.

(c) Few candidates gave the appropriate sequence of points beginning with variation and ending with inheritance of alleles for the adaptive features. Many candidates referred to extreme conditions as acting as selective agents rather than one or more of these conditions, such as the cold. Many candidates wrote in simple terms about 'strong' and 'weak' sheep and the 'survival of the fittest'. None of these answers gained much, if any, credit. Very few candidates muddled artificial and natural selection. It was quite common to read responses that stated that the sheep adapted to the extreme conditions by growing more fur, and some candidates confused this with artificial selection, with humans selecting the sheep to breed.

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Paper 0610/33
Extended Theory

Key Messages

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- Candidates should avoid writing initial answers in pencil and then overwriting in pen and should also not use thick felt tip pens as the ink run through can affect the clarity of the answer overleaf.

General Comments

A full range of responses to all the questions was seen and all points on the mark scheme were awarded. There were many good answers from candidates who showed great confidence not only in handling the information that they had learnt, but also in applying it successfully to novel contexts. Many showed skill in analysing the data in the graphs in Fig. 2.1 and Fig. 6.1. Although no questions stood out as being inaccessible, very few candidates scored full credit for the data response questions including **Questions 2(c)(i)**, and **(ii)**, **4(b)** and **6(c)**. Time spent analysing the data in these questions and phrasing responses probably meant that candidates were short of time. There were several part questions, especially in **Question 3** and in **Question 2**, that were not attempted on some scripts. Many candidates did not attempt **Questions 3(b)(ii)** and **(iii)** on the functions of the kidney tubule and **Question 2(b)** on genetic engineering.

Candidates should avoid writing out the information in the questions at the start of their answers. There were several questions where this was seen, including **Questions 1(d)** and **(e)**, **3(c)** and **4(b)**. There was evidence that candidates had not always paid attention to the mark allocation for each question, for example in answering **Questions 5(c)** and **6(b)** candidates often did not give the number of expected points in their answers.

Many answers to **Question 3(c)** displayed a very poor grasp of plant biology. For example, candidates stated that water is absorbed from the soil by xylem, ions are required for respiration and photosynthesis

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occurs in roots. Many candidates did not make the link between respiration that provides energy for cell activities and the active uptake of ions from the soil, which is one of those activities.

Comments on specific questions

Question 1

(a) Most candidates gave the correct answer. A common spelling error was 'anthropod'.

(b) Candidates were expected to select visible features, which many did, but there was a tendency to use inappropriate terms, such as 'whiskers', 'fur', 'body', 'tail' and 'hands', despite the labelled diagram of a crab in Fig. 1.1. Answers from some candidates were too brief and not specific enough, for example 'eyes' unqualified by any further information did not gain credit, but 'eyes on stalks' and 'eyes not on stalks' were acceptable answers.

(c) (i) Most candidates selected a feature that could be measured, although many gave 'size' or 'shape' without further elaboration of a suitable feature. Categorical variables, such as 'presence of hair', were the most common wrong answers, suggesting that a number of candidates did not understand what was meant by continuous variation.

(ii) Only a small percentage of candidates qualified their selection in **(i)** with a suitable measuring technique. Some of these gave very detailed answers. There was a significant number who did not attempt this question. Some candidates who did not give acceptable answers to part **(i)** gave answers here that made it clear what they intended as their chosen feature. Where this happened the Examiners awarded credit for part **(i)**.

(d) Many candidates gained maximum credit, with the best answers making reference to the principles of 'carrying capacity' and 'limiting factors'.

(e) There were many confident answers from candidates who used their knowledge of blood and infections and applied it to the healing of wounds. There were, however, many responses where candidates restated the question stem without elaboration.

Question 2

(a) (i) Many candidates gave the correct answer. As well as amino acids, the Examiners accepted peptides, which were suggested by some candidates. A small minority gave the names of elements, and others gave large molecules such as enzymes.

(ii) The majority of candidates were well prepared, giving very thorough definitions of growth. The most common error was to describe development rather than growth.

(b) A minority of candidates showed a very good understanding of genetic engineering and gave excellent descriptions of the process. Less able candidates used the information that bacteria were involved in the process and stated that these reproduce when kept in an appropriate culture medium. 'Reproduction in fermenters' was commonly mentioned, although often in the wrong context. Many responses gave confused descriptions that attempted to include too much detail, resulting in inaccuracies that were not creditworthy. A few candidates gave descriptions of insulin production, but credit was not awarded for the stages that are common to both processes. A common error was to state that BST, or 'the hormone', is inserted into DNA or is inserted directly into the bacteria. Candidates omitted to state that it is the gene for BST that is cut out of the bovine genome and inserted into a plasmid. Some candidates simply gave a definition of genetic engineering rather than applying their understanding to the context. Many omitted this question.

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(c) (i) There were many excellent answers to this question. These were given with suitable comments on the effects of treatment, with supporting data quotes. The most common errors included:

- misusing the units or not giving any units at all;
- attempting to include 'all' the data without specifically selecting significant points on the two graphs;
- misreading data points;
- placing emphasis on the untreated cows in group **B**, without reference to data for the cows treated with BST;
- quoting 'days' instead of 'weeks' and omitting 'per day' from the data on milk yield;
- omitting an overview of the general shapes of the graphs.

(ii) There were some very well-considered answers with most candidates realising the impact of the increase in food intake on the profitability of using BST. Only a few candidates gave accurate data quotes.

(d) Many candidates did not consider enough different points in order to gain full credit for this question. The most common reason given for labelling was a potential impact of the milk on human health.

Question 3

(a) Many candidates correctly identified two or three of the regions of the kidney indicated in Fig. 3.1. The ureter was identified by many more than the cortex and/or medulla. Many gave cortex and medulla the wrong way round. Another common error was to muddle the ureter with the urethra and, although phonetic spelling is generally accepted, incorrect spelling cannot be credited where it is ambiguous.

(b) (i) Many good answers were seen with very detailed explanations, but in some answers there was little agreement between letter and reason. Some candidates wrote about active transport in the first row where they had identified **H**, and diffusion in the second row where they had identified **L**. A number of candidates put several letters in the spaces provided; no credit was awarded for these answers. The Examiners marked the two columns independently so where this happened credit was given for the final column if the reasons were correct for diffusion and active uptake.

(ii) The site of filtration in the kidney was known by a fair number of candidates. The medulla was the most common incorrect answer.

(iii) This question was the least well answered on the paper. Very few candidates made reference to Fig. 3.2 to help them plan or write their answers. There were many references to osmosis and diffusion in the answers rather than active uptake.

(c) Many candidates suggested that plants would not require minerals if respiration was halted, or that photosynthesis would take place as an alternative. Others considered axial transport with reference to xylem and phloem rather than the transport of nutrients and water into the root from the soil. Many also stated incorrectly that energy is 'produced' in respiration.

Question 4

(a) The end products of both processes were well known by many, but answers were occasionally spoilt by the use of incorrect chemical formulae. Most of the errors were in the aerobic column, where it was common for candidates to know the end products of aerobic respiration of a human muscle cell, without realising that they are the same in yeast.

(b) There were many good answers to this question, although they often included repetition of the same point – the need for more oxygen. Credit was not awarded where there were references to 'production' of energy. A minority of candidates wrote entirely of events *after* exercise, such as paying back the oxygen debt and removing lactic acid; these answers did not gain maximum credit. A common error was to state that during exercise there is increased blood flow and oxygen supply *to the body*. The focus of candidates' answers to this type of question should be the muscles. It is important that candidates refer to the supply of blood to specific *parts of the body*, such as muscles, brain and skin.

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Question 5

(a) Transmission of disease was often correctly explained. Candidates found it much harder to explain the term 'drug' correctly, and often omitted to state that drugs are chemicals that are taken *into* the body. This distinguishes them from endogenous hormones which are also chemicals that affect chemical reactions in the body.

(b) Although there were some good answers to this question, candidates rarely gave correct references to lymphocytes, phagocytes, sickness or diarrhoea, with the majority of candidates making generalised statements about 'harm to the body' or 'fatal' effects that were not credited. Other candidates confused the term 'antibodies' with antigens or antibiotics. A large number of candidates gave only two creditworthy points: bacteria in the milk, and a weak immune system because of HIV.

(c) This question was well answered by many who gave a series of different points. Although forming a bond between baby and mother was the most common suggestion, a wide range of other points were given by candidates. Very few incorrect answers were seen. The most common reason for candidates not obtaining maximum credit was that they gave fewer than four different points.

(d) Most candidates gave two ways in which HIV may be transmitted to an adult. There were some vague references to 'blood' and 'body fluids' rather than stating that HIV is transmitted when there is blood to blood contact, for example in blood transfusion,. There were some suggestions that HIV is an 'inherited condition'.

Question 6

(a) Many answers successfully linked the points about fertilisers with the roles of nitrogen and magnesium in plant growth. Common errors included failure to link nitrogen to protein synthesis or magnesium to chlorophyll synthesis. A minority thought that chemical fertilisers included pesticides, herbicides and plant hormones. The Examiners ignored the parts of answers that included anything about other agricultural chemicals.

(b) This question was very well answered with most candidates giving three different conditions. Although some candidates stated 'temperature' without any qualification, most knew that a warm or suitable temperature was required. The most common incorrect answer given was 'nutrients'.

(c) As in previous data questions, excellent responses were seen, but again candidates did not always select data appropriately and therefore answers were not given full credit. Sometimes correct data did not gain credit because it was not comparative or did not include a reference to time. A significant number of responses confused roots and shoots or gave descriptions of roots and shoots *decreasing* in length.

(d) This question was generally well answered. The most common error was to state that the burning of fossil fuels was responsible for the increase in sulfur dioxide in the atmosphere over the past 150 years; it is the *increased* use of fossil fuels that is responsible. Some also explained the increase in global warming rather than the increase in atmospheric sulfur dioxide concentrations.

(e) Some of the statements about the environmental effects of acid rain were too general in nature and lacked the clarity required. For example, there were very few references to mucus production in fish gills. Vague answers such as 'poisons organisms' and 'pollutes water' were seen more frequently. References to increases in pH and to eutrophication were common errors.

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Paper 0610/04

Coursework

Key Messages

- Offering a choice of tasks that allow access to all aspects of the criteria is the key to ensuring fair and reliable assessment.
- All work must be original, not fair copies; the candidates' own, unaided work.
- All work should be clearly marked by the teacher, showing how marks have been awarded.

General Comments

All Centres submitting coursework samples for this examination session provided full, clear documentation, which was greatly appreciated.

The majority used between 6 and 12 tasks, carefully chosen to allow each candidate to have at least three assessment chances for each of C1, C2 and C3. For C4, most Centres offered only two tasks, as these take much more time to complete. Several Centres assessed C4 on its own (i.e. not in combination with other skills), but some used C4 tasks for the assessment of either C2 or C3 as well.

The range of tasks varied widely. In general, C3 and C4 provide best opportunities for candidates to reach marks of 5 or 6 if they generate quantitative results that can be graphed. C4 tasks require the investigation of the effect of one variable on another, as otherwise candidates cannot demonstrate the key ability to identify these variables and to control others that might affect their results. Tasks looking for correlations between two features (e.g. volume and mass) do not provide this opportunity. C3 tasks must provide opportunities for discussing sources of experimental error and again quantitative tasks involving control of variables often provide the best scenarios for this. More information about this can be found in the *Coursework Training Handbook (Part **1**): Guidance*, available from the 0610 pages on the teacher support web site.

However, the fact that a particular piece of practical work does not allow access to all of the criteria for a particular skill does not mean that it should not be done. It is important to recognise that practical work has many values other than assessment, and there will be many types of practical activity that are well worth spending time on, but that are not suitable for Paper 4 assessment.

Most Centres provided carefully constructed mark schemes. It is important that these are always task-specific, building from the generic criteria provided in the syllabus. Purely generic mark schemes are not appropriate, as they do not allow reliable assessment. Generic criteria can be shared with the candidates, but the task-specific mark schemes should not be shown to them.

Skill C1 does not provide any written evidence from the candidates, but the Moderators need to see evidence of how the Centre has assessed this skill. Most did this by providing tick sheets showing a record of what each candidate has done during each C1 task, but some provided no evidence at all.

The samples of work should be the original work done by the individual candidates. Just as for any examination paper, this work must be unaided. In practice, this means that the work should be done under supervision. The simplest way of ensuring this is to require candidates to write up their experiments as they go along, or immediately afterwards, while still in the laboratory or classroom. If they have access to a computer in this circumstance, it is fine for this work to be word processed. It is not acceptable for candidates to work in conditions where they may be able to obtain help from others, or where they work together. Some Centres appear to be encouraging candidates to produce work where high quality

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presentation is a major feature. This is not at all what the Moderators want to see. It is the content of the work, and evidence that it is unaided, that are the key features being looked for.

Most Centres mark work fully, and the comments written on the work samples are very helpful in showing how marks have been awarded. A few Centres did not do this, generally where work had been word processed. This raises the possibility that the work has been redrafted after being marked, which not acceptable practice. The Moderators need to see original, marked work.

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Paper 0610/51

Practical Test

Key Messages

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

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

Drawings should have a clear continuous outline and be labelled. The guide line for a label must make contact with the structure intended without a gap or an arrow head.

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

General comments

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

Plotting graphs need to be scaled so the plots fit and use most of the available grid with plots covering more than half in both dimensions. The correct choice of graph to represent the data accurately is important and in this paper candidates were required to present the data as a bar chart using discrete columns of equal width labelled clearly on the axis.

Comments on specific questions

Question 1

(a) Most candidates successfully identified differences in the shapes of the three types of seeds but were less accurate when describing the appearance. The most common error was to choose a feature that was the same for all the seeds, e.g. shiny.

(b) (i) Most candidates were familiar with the use of biuret to show that lentil seeds contain protein. It is important to describe the colour change and although many candidates knew that it would become purple, they did not refer to the original colour. A small number of candidates incorrectly heated the biuret with the seed.

(ii) Many candidates were familiar with the use of ethanol to show that lentil seeds contain fat. Candidates were given independent credit for the additions of alcohol and water and the appearance of the emulsion or cloudy/white result. The most common error was to omit the water. Only the better candidates gained full credit.

A few candidates gained partial credit for a correct description of the grease spot test and there were a small number of incorrect diet related answers.

(c) Many candidates did not get the expected results and this is because they did not leave the seeds for long enough.

(d) (i) Overall, the bar charts were well constructed and well presented. Vertical or horizontal bars were accepted.

The labels for the axes should be taken directly from the headings on the table of results. The majority of candidates only used ‘percentage’ but credit was given.

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Most candidates chose an appropriate scale, using more than half of the available grid for their plots, and axes were labelled correctly. A small number of weaker candidates incorrectly took the percentage values from the table and placed them equally along the axis. A common error was that candidates did not use the same axes for their plots. These candidates lost credit for their axes but were given credit for their plots. Some candidates constructed two bar charts, either side by side or one above the other. They were given credit when they used the same axes for both. A small number of weaker candidates incorrectly tried to plot the percentage protein and fat values against each other without having an axis for the seeds.

Most candidates plotted their bars correctly and few errors were seen. Some candidates chose to plot the fat and protein percentage values side by side, and others chose to use one bar but represent both values within it. Both were acceptable.

The bars for the different seeds should be separate but a common error was to draw all the bars touching. Those candidates who plotted the fat and protein values side by side for each seed were given credit if these bars touched, as long as there were spaces between the different seeds. A small number of candidates did not draw bars of equal width.

Most candidates used appropriate labels or a key to distinguish between the values for the protein and fat. Many variations were accepted.

(ii) Most candidates correctly chose the soya bean seed.

(e) The better candidates recognised the need to measure the change in temperature of the water, or at least the initial and final temperatures of the water. The most common errors were to say that the temperature would be measured throughout the experiment or only at the end of the experiment. Some candidates did not understand the experiment and incorrectly stated that the temperature reached was equivalent to the energy released.

Only the better candidates correctly identified what had to be controlled. A number of candidates were confused between 'to measure' and 'to control' and some of them incorrectly said that they would need to control the temperature. A common error was to suggest setting up a control such as having the same experiment with dead soya beans.

Many candidates correctly identified a safety measure but some candidates' answers only listed safety measures.

Quite a number of weaker candidates designed completely different experiments. One other common error was to ignore any experimental procedure and use the mass of the soya beans to calculate the energy content of the beans using the information from the label given in Fig. 1.1.

Question 2

(a) This was completed by many candidates.

(b) The difference between the cucumber immediately on immersion and 10 minutes after immersion was not obvious in the diagrams of most candidates, which suggests that the instructions were not followed carefully enough. The slice of cucumber should have been a maximum of 2 mm thick. If this was exceeded, then there would be no change after 10 minutes.

(c) Overall, this was not answered well. The observation that both tissues had not changed meant that they could not explain why. There were a number of more able candidates who did get different results, understood the process and explained it well. A common error was to say that solution **E** was moving in and out of cells rather than water. A number of candidates only described the effects instead of explaining the results. Explanations of the concentration gradients were poorly described.

(d) This was not answered well and only a small number of more able candidates gained full credit here.

Some candidates identified temperature or timing as a source of error, but did not identify the error as the fact that they were different for each piece of cucumber. They were given credit for an

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improvement to keep them both the same. A small number of candidates did identify the need for repeating the procedure. The most common errors were different volumes of solution and water, inaccurate timing or inaccurate measurements of the thickness of the slice. A small number of candidates incorrectly stated that there should have been a control experiment.

Question 3

(a) (i) This question was poorly answered. The majority of candidates did not know that molluscs have tentacles and many answers used the incorrect terms, antennae, anthers or antlers. Common errors were the presence of eyes and that both animals were slimy or soft, but neither of these were visible in Fig. 3.1. 'Unsegmented' was quite well known but only better candidates knew about the muscular foot.

(ii) Most candidates successfully identified the shell as a visible difference between the slug and the snail.

(b) (i) Overall the shells were drawn well and the lines used were single, continuous and clear. The most common error was to include shading; there should be no shading in a biological drawing. Most drawings were drawn larger than the specimen and accurately represented details of the shell. Some drawings did not give enough detail of the opening or the surface of the shell.

(ii) The majority of candidates only stated protection or hiding, but the better candidates did qualify their answer in terms of protection against predators or a named environmental factor. A small number correctly referred to the shell preventing the snail drying out.

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Paper 0610/52

Practical Test

Key Messages

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

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

Drawings should be large enough to include detail, have a clear continuous outline and be labelled. The guide line for a label must make contact with the structure intended without a gap or an arrow head.

Plotting graphs need to be scaled so the plots fit and use most of the available grid with plots covering more than half of the available area in both dimensions.

Magnifications based on the original specimen and the candidates' drawings require accurate measurements using appropriate requested SI units to complete the calculation.

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

General comments

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

The correct choice of graph to represent the data accurately is important and in this paper candidates were required to present the data as a histogram.

Comments on specific questions

Question 1

(a) (i) Candidates carried out the investigations based on the action of catalase and recorded the number of bubbles released in one minute using extracts from ground up seeds and seedlings that had been germinated for four days. These observations were recorded in Table 1.1.

(ii) Less able candidates only repeated the data without comparing the two sources of extracts. Few candidates processed the data on a numerical basis. This investigation was based on catalase activity and had no connection to photosynthesis or respiration.

(iii) To draw a conclusion is to state whether or not the investigation supported the aim of the investigation. In this question the intent was to compare the activity of the enzyme, catalase, from the two sources of extracts. Many candidates did not seem to understand what is meant by a conclusion. This requirement is included in the list of practical skills. It is not sufficient to compare the number of bubbles released.

(b) (i) The need to repeat the tests with the extracts was to increase the reliability of the data. There were confused ideas expressed over the term 'accuracy'.

(ii) The suggested reasons why the seeds and seedlings were crushed to prepare an extract, and not used as whole seeds and seedlings, included the idea that the enzyme was to be found inside the outer layer, the testa or seed coat. Many candidates linked this to an increase in surface area and greater activity, or that the outer layer could not react with the hydrogen peroxide. A few candidates realised that the seeds might be too large to fit into the test-tubes. It appeared that

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some candidates did not understand the question. Responses referring to 'accuracy' or 'extracts were easier to use' did not answer the question.

(c) (i) Common errors included differences in the 'amounts' of extract or hydrogen peroxide solutions, timing procedures with counting the bubbles, size of bubbles and temperature. Reference to 'amounts' of extract and/or hydrogen peroxide solutions were common responses. The term 'amount' is too general, and 'concentration' and 'volume' should be considered.

(ii) To reduce an error, it is important to refer to the method to which the improvement needs to be applied. For example, to measure the 'amount' of a solution, use of a technique to find a precise volume is required. Several candidates referred to the involvement of a water-bath to control temperature fluctuations, or the use of a buffer to control pH.

(d) (i) Many candidates were able to correctly measure the height of the foam in millimetres. Errors included measurements recorded in centimetres without changing the units used, recording an incorrect decimal, e.g. 45 mm as 40.5 mm, or the use of non SI units.

(ii) The question required a second conclusion, to link the observation of the height of the foam to the enzyme activity. Many candidates linked the greater height of the foam to the seed data instead of catalase.

(iii) Although several candidates stated the conclusions for **(d)(ii)** and **(a)(ii)**, many were not able to fully explain the consistency of the two conclusions other than a trend with more bubbles and greater height of foam for the seeds compared with seedlings.

Question 2

(a) (i) Candidates were expected to measure the maximum length of five seeds in millimetres. Errors included measurements recorded in centimetres without changing the units used, recording an incorrect decimal, e.g. 25 mm as 20.5 mm, or the use of non SI units.

(ii) It appeared that some candidates were not familiar with the concept of tally charts. This lead to many tally tables that were not completed. It was incorrect to just record the five beans by the letters instead of tally marks.

(iii) Completion of the number column in the tally chart was achieved by most candidates, even those who had been unable to include the tallies for the five measured beans.

(iv) Most candidates presented the data as a histogram with labelled axes showing the ranges of maximum length and number of beans in each group, suitable size, accurate plots and columns that were drawn of equal width and in contact. The orientation of the columns was mainly vertical but some were presented horizontally. A few candidates confused the orientation of the columns with the labelling of the axes. Common errors in labelling of the axes included the omission of the units and the range of lengths for each category of 'bean length'. The scale was usually evenly spaced along the length of the axis, often with a sign below the first range category to show the discontinuity. Only a few candidates presented the numbers directly from the table in a non-linear scale in the incorrect order. Candidates need to construct the columns using neat, ruled lines; many histograms showed freehand, unevenly drawn columns. Few line graphs and bar charts were seen.

(v) The type of variation shown by the bean seeds was 'continuous variation' covering an overall range of 24.0 mm to 35.9 mm without gaps between the different lengths. Some candidates incorrectly recorded 'discontinuous' or did not attempt this part of the question.

(b) (i) The standard of drawings achieved by most candidates was high. A neat outline was used to show a complete bean larger than the specimen provided. If the size of the drawing is too small it is difficult to show the detail. A few candidates did not follow the rubric to remove the seed coat, the testa, as this layer was shown in the drawings and labelled. The radicle was shown quite clearly and in proportion to the size of the seed, but sometimes the outline of the plumule was not clear. The labelling was often omitted. The correct terms for parts of an embryo should be familiar to candidates. These terms, such as radicle, were not always used. In order to construct an accurate image, it is important that candidates take time to draw the bean and not rush the observation of the details.

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(ii) Most candidates accurately measured both the actual bean and their drawing. The majority showed either a line across the maximum length of their drawing or two vertical lines placed either side of the bean drawing to measure the maximum length in millimetres. Errors included measurements recorded in centimetres without changing the units used, recording an incorrect decimal, e.g. 95 mm as 90.5 mm or the use of non SI units. A few candidates measured the maximum width instead of length. Other candidates failed to show any indication of a line on their drawings. The formula to calculate the magnification was well known and applied by most candidates. Magnification does not have a unit; where units were included the answer was ignored.

(c) Most candidates were familiar with the biuret test to show the presence of protein and the colour change involved. A common error was to omit the starting colour.

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Paper 0610/53
Practical Test

Key Messages

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General comments

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

The correct choice of graph to represent the data accurately is important and in this paper candidates were required to present the data as a histogram.

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(ii) Less able candidates only repeated the data without comparing the two sources of extracts. Few candidates processed the data on a numerical basis. This investigation was based on catalase activity and had no connection to photosynthesis or respiration.

(iii) To draw a conclusion is to state whether or not the investigation supported the aim of the investigation. In this question the intent was to compare the activity of the enzyme, catalase, from the two sources of extracts. Many candidates did not seem to understand what is meant by a conclusion. This requirement is included in the list of practical skills. It is not sufficient to compare the number of bubbles released.

(b) (i) The need to repeat the tests with the extracts was to increase the reliability of the data. There were confused ideas expressed over the term 'accuracy'.

(ii) The suggested reasons why the seeds and seedlings were crushed to prepare an extract, and not used as whole seeds and seedlings, included the idea that the enzyme was to be found inside the outer layer, the testa or seed coat. Many candidates linked this to an increase in surface area and greater activity, or that the outer layer could not react with the hydrogen peroxide. A few candidates realised that the seeds might be too large to fit into the test-tubes. It appeared that

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some candidates did not understand the question. Responses referring to 'accuracy' or 'extracts were easier to use' did not answer the question.

(c) (i) Common errors included differences in the 'amounts' of extract or hydrogen peroxide solutions, timing procedures with counting the bubbles, size of bubbles and temperature. Reference to 'amounts' of extract and/or hydrogen peroxide solutions were common responses. The term 'amount' is too general, and 'concentration' and 'volume' should be considered.

(ii) To reduce an error, it is important to refer to the method to which the improvement needs to be applied. For example, to measure the 'amount' of a solution, use of a technique to find a precise volume is required. Several candidates referred to the involvement of a water-bath to control temperature fluctuations, or the use of a buffer to control pH.

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(ii) It appeared that some candidates were not familiar with the concept of tally charts. This lead to many tally tables that were not completed. It was incorrect to just record the five beans by the letters instead of tally marks.

(iii) Completion of the number column in the tally chart was achieved by most candidates, even those who had been unable to include the tallies for the five measured beans.

(iv) Most candidates presented the data as a histogram with labelled axes showing the ranges of maximum length and number of beans in each group, suitable size, accurate plots and columns that were drawn of equal width and in contact. The orientation of the columns was mainly vertical but some were presented horizontally. A few candidates confused the orientation of the columns with the labelling of the axes. Common errors in labelling of the axes included the omission of the units and the range of lengths for each category of 'bean length'. The scale was usually evenly spaced along the length of the axis, often with a sign below the first range category to show the discontinuity. Only a few candidates presented the numbers directly from the table in a non-linear scale in the incorrect order. Candidates need to construct the columns using neat, ruled lines; many histograms showed freehand, unevenly drawn columns. Few line graphs and bar charts were seen.

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(b) (i) The standard of drawings achieved by most candidates was high. A neat outline was used to show a complete bean larger than the specimen provided. If the size of the drawing is too small it is difficult to show the detail. A few candidates did not follow the rubric to remove the seed coat, the testa, as this layer was shown in the drawings and labelled. The radicle was shown quite clearly and in proportion to the size of the seed, but sometimes the outline of the plumule was not clear. The labelling was often omitted. The correct terms for parts of an embryo should be familiar to candidates. These terms, such as radicle, were not always used. In order to construct an accurate image, it is important that candidates take time to draw the bean and not rush the observation of the details.

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(c) Most candidates were familiar with the biuret test to show the presence of protein and the colour change involved. A common error was to omit the starting colour.

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Paper 0610/61

Alternative to Practical

Key Messages

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

In **Question 1** there was the need to follow instructions and use observational skills; to recall investigation planning skills such as identification of variables; to present accurate, labelled drawings; to describe safe procedures for food tests; to measure distance using correct SI units; to present data in correct graphic form and to plan an investigation.

In **Question 2** candidates were given an outlined investigation and they had to make observational descriptions based on diagrams; to explain observations; to identify a source of error in the plan and to suggest an improvement.

In **Question 3** candidates were given diagrams of two animals and had to use their observational skills to classify the animals and make suggestions for the function of an identified feature.

General comments

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

It is important that candidates use a good HB pencil and eraser for drawings and graph construction. Drawings should have a clear continuous outline and be labelled. The guide line for a label must make contact with the structure intended without a gap or an arrow head. Magnifications based on the photographed image and the candidates' drawings require accurate measurements and calculation.

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

Plotting graphs need to be scaled so the plots fit and use most of the available grid with plots covering more than half in both dimensions. The correct choice of graph, to represent the data accurately, is important and in this paper candidates were required to present the data as a bar chart using discrete columns of equal width labelled clearly on the axis.

Comments on specific questions

Question 1

(a) Three black and white photographs of different types of bean seeds were provided. Apart from shades of grey, colours could not be observed and neither could textures. No scale was included with these images so relative size could not be considered. Most candidates successfully identified differences in the shape of the three types of seeds but were less accurate when describing the appearance. The most common error was to choose a feature that was the same for all the seeds e.g. shiny.

(b) Candidates were required to select suitable variables for an investigation into the effect of temperature on the germination of seeds. This was not well understood as only a small number of candidates chose both correct variables and all possibilities were seen.

(c) (i) Candidates were instructed to make a large labelled drawing of the photograph of a lentil seedling shown in Fig. 1.2.

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Overall the seedlings were well drawn and the lines used to draw the seedling were single, continuous and clear. The most common error was to include shading. Although some parts do look darker on the photograph there should be no shading in a biological drawing. Most drawings were drawn larger than the photograph and accurately represented details of the seedling.

Many candidates did not know the basic parts of the seedling; often root, stem and leaf were labelled incorrectly. The most common error, however, was that the label lines from the name did not touch the part of the seedling they were supposed to identify.

(c) (ii) Most measurements for the lines **ST** on the photograph and candidate's drawing were accurate. A small number of candidates did not draw a line **ST** on their drawing. A common error was to measure the lengths in cm not mm and fail to adjust the units in their answer.

Most candidates accurately calculated the magnification but a small number divided their measurements the wrong way round giving an answer less than one. Candidates should look at their answer in relation to their drawing to have a quick check that their magnification is correct. The drawings were usually larger than the original and so would have a magnification greater than one. The expression of magnification is with 'x' but a small number of candidates incorrectly gave units as well.

(d) (i) Most candidates were familiar with the use of biuret to show that lentil seeds contain protein. It is important to describe the colour change and although many candidates knew that it would become purple they did not refer to the original colour. A small number of candidates incorrectly heated the biuret with the seed. There were a few candidates who may not have been familiar with food tests and they, incorrectly, gave answers relating to diet or blood tests.

(d) (ii) Many candidates were familiar with the use of ethanol to show that lentil seeds contain fats. Candidates were given independent credit for the additions of alcohol and water and the appearance of the emulsion or cloudy / white result. The most common error was to omit the water. A few candidates gained partial credit for a correct description of the grease spot test and, again, there were a small number of incorrect diet related answers.

(e) (i) Using the measurements from **Table 1.2,** candidates were asked to construct a bar chart, using the same axes, to show the percentages of protein and fat in five types of seed.

Overall, the bar charts were well constructed and well presented. Vertical or horizontal bars were accepted. The labels for the axes should be taken directly from the headings on the table of results. The majority of candidates only used 'percentage' but credit was given.

Most candidates chose an appropriate scale, using more than half of the available grid for their plots, and they labelled their axes correctly. A small number of weaker candidates incorrectly took the percentage values from the table and placed them equally along the axis. A common error was that candidates did not use the same axes for their plots. These candidates lost the mark for their axes but were given credit for their plots. Some candidates constructed two bar charts, either side by side or one above the other. They were given credit when they used the same axes for both. A small number of weaker candidates incorrectly tried to plot the percentage protein and fat values against each other without having an axis for the seeds.

Most candidates plotted their bars correctly and few errors were seen. Some candidates chose to plot the fat and protein percentage values side by side and others chose to use one bar but represent both values within it. Both were acceptable.

The bars for the different seeds should be separate but a common error was to draw all the bars touching. Those candidates who plotted the fat and protein values side by side for each seed were given credit if these bars touched, as long as there were spaces between the different seeds. A small number of candidates did not draw bars of equal width.

Most candidates used appropriate labels or a key to distinguish between the values for the protein and fat. Many variations were accepted.

(e) (ii) Most candidates correctly chose the soya bean seed.

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(f) Candidates were given the basic method and apparatus for an investigation to find the energy content of soya seeds.

The better candidates recognised the need to measure the change in temperature of the water or at least the initial and final temperatures of the water. The most common errors were to say that the temperature would be measured throughout the experiment or only at the end of the experiment. Some candidates did not understand the experiment and incorrectly stated that the temperature reached was equivalent to the energy released.

Only the better candidates correctly identified what had to be controlled. A number of candidates were confused between 'to measure' and 'to control' and some of them incorrectly said that they would need to control the temperature. A common error was to suggest setting up a control such as having the same experiment with dead soya beans.

Many candidates correctly identified a safety measure but some candidates' answers only listed safety measures.

Quite a number of weaker candidates designed completely different experiments. One other common error was to ignore any experimental procedure and use the mass of the soya beans to calculate the energy content of the beans using the information from the label given in **Fig. 1.3.**

Question 2

This question was based on a candidate's investigation to see the effect of solution **E** on cucumber. Candidates were asked to describe the effects of solution **E** and water on the outer dark green tissues and the pale green inner tissue of the cucumber from the candidate's diagrams in **Table 2.1.**

(a) (i) According to the diagrams, the appearance of the dark green tissue in solution **E** had become more curved and longer. Common errors were to say that it had curved but not that it had curved **more** and a number of candidates incorrectly stated that it had shrunk.

Common errors for the tissue in water were to say it had changed length or to say that it had changed shape without describing how.

A small number of candidates tried to explain the changes in terms of osmosis rather than describe the changes that could be seen.

(a) (ii) As in **(a)(i)**, some candidates did not say that the pale green tissue had curved more in solution **E**. A small number of candidates incorrectly stated that it had become wider.

The most common error for water was to refer to changes in length. Again, some candidates tried to explain what had happened rather than describe what they could see.

(b) Candidates were asked to explain the effect of solution **E** on the tissues of the cucumber. According to the diagrams drawn in **Table 2.1** there could be two different explanations in terms of osmosis. Both alternatives were acceptable but, overall, this was not answered well.

The observation that both tissues had curved more could be explained by the fact that the tissues had become flaccid. There were a number of more able candidates who understood the process and explained it well. The observation that both tissues had increased in length, could be explained by the fact that the tissues had become turgid. A smaller number of candidates correctly explained this.

A common error was to say that solution **E** was moving in and out of cells rather than water. A number of candidates only described the effects instead of explaining the results.

(c) Candidates were asked to state one possible error in the method used for this investigation and suggest a suitable improvement. This was not answered well and only a small number of more able candidates gained full marks here.

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Some candidates identified temperature or timing but did not identify the error as the fact that they were different for each piece of cucumber. They were given credit for an improvement to keep them both the same. A small number of candidates did identify the need for repeating the procedure. The most common errors were different volumes of solution and water, inaccurate timing of the 5 minutes or inaccurate measurements of 2 mm. A small number of candidates incorrectly stated that there should have been a control experiment.

Question 3

(a) (i) Candidates were given drawings of a slug and a snail and asked to describe two visible features which suggest that the two animals both belong to the group molluscs This question was poorly answered. The majority of candidates did not know that molluscs have tentacles and there were many answers using the incorrect terms: antennae, anthers or antlers. Common errors were the presence of eyes, but these were not visible, and that both animals were slimy or soft, but this could not be seen in the diagrams. 'Unsegmented' was quite well known but only better candidates knew about the muscular foot.

(a) (ii) M**o**st candidates successfully identified the shell as a visible difference between the slug and the snail.

(b) Candidates were asked to suggest the importance of the shell to the molluscs. The majority of candidates only stated protection or hiding but the better candidates did qualify their answer in terms of protection against predators or a named environmental factor. A small number correctly referred to the shell preventing the snail drying out.

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Alternative to Practical

Key Messages

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

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

Drawings should be large enough to include detail, have a clear continuous outline and be labelled. The guide line for a label must make contact with the structure intended without a gap or an arrow head.

Plotting graphs need to be scaled so the plots fit and use most of the available grid with plots covering more than half of the available area in both dimensions.

Magnifications based on the original specimen and the candidates' drawings require accurate measurements using appropriate requested SI units to complete the calculation.

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

General comments

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

The correct choice of graph to represent the data accurately is important and in this paper candidates were required to present the data as a histogram.

Comments on specific questions

Question 1

(a) (i) Candidates used the data in Table 1.1 to describe the differences between the results for seeds versus seedlings. Less able candidates simply repeated the data without any comparison. Few candidates processed the data on a numerical basis. This investigation was based on catalase activity and had no connection to photosynthesis or respiration.

(ii) A conclusion should state whether the investigation supported the intention. In this question the intent was to compare the activity of the catalase activity from the two sources of extracts. Many candidates did not seem to understand what is meant by a conclusion. This requirement is included in the list of practical skills. It was not sufficient to just compare the number of bubbles released.

(b) (i) Common sources of errors given included differences in the 'amounts' of extract or hydrogen peroxide solutions, timing procedures with counting the bubbles, size of bubbles and temperature. Reference to 'amounts' of extract and/or hydrogen peroxide solutions were common responses. The term 'amount' is too general, and 'concentration' and 'volume' should be considered.

(ii) To reduce an error, it is important to refer to the method to which the improvement needs to be applied. For example, to measure the 'amount' of a solution, use of a technique to find a precise volume is required. Several candidates referred to the involvement of a water-bath to control temperature fluctuations, or the use of a buffer to control pH.

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(c) (i) Many candidates were able to correctly measure the height of the foam in millimetres. Errors included measurements recorded in centimetres without changing the units used, recording an incorrect decimal, e.g. 45 mm as 40.5 mm, or the use of non SI units.

(ii) The question required a second conclusion to link the observation of height of the foam to the enzyme activity. Many candidates linked the greater height of the foam to the seed data instead of catalase.

(iii) Although several candidates stated the conclusions for **(c)(ii)** and **(a)(ii)**, many were not able to fully explain the consistency of the two conclusions other than a trend with more bubbles and greater height of foam for the seeds compared with seedlings.

(d) (i) The need to repeat the tests with the extracts was to increase the reliability of the data. There were confused ideas expressed over the term 'accuracy'.

(ii) The suggested reasons why the seeds and seedlings were crushed to prepare an extract, and not used as whole seeds and seedlings, included the idea that the enzyme was to be found inside the outer layer, the testa or seed coat. Many candidates linked this to an increase in surface area and greater activity, or that the outer layer could not react with the hydrogen peroxide. A few candidates realised that the seeds might be too large to fit into the test-tubes. It appeared that some candidates did not understand the question. Responses referring to 'accuracy' or 'extracts were easier to use' did not answer the question.

(e) This question was based on suggestions for three different variables involved in planning a similar investigation on the activity of catalase in different types of seeds. Many incorrect variables were suggested; it is important that candidates should be aware of the types of variables for planning investigations.

(i) The investigation to be planned referred to the enzyme activity in 'different types of seeds'.

(ii) Most candidates gave just one correct variable. The use of the general term 'amount' of extract or hydrogen peroxide solution should be replaced by reference to 'mass', 'volume' or 'concentration'. Certain variables, e.g. 'time', needed to be qualified to explain if the timing was intended for the whole investigation or just for counting the number of bubbles.

(iii) The variable to measure is the dependent variable. This term needs to be included in the planning of investigations. Many candidates referred to bubbles, oxygen or foam. It is necessary to record how these should be quantified, e.g. counting the number of bubbles released in a set time period, volume of oxygen to be collected or maximum height of foam to be measured.

(iv) The involvement of a control experiment is for comparison to the reaction that is to be carried out. A design based on enzyme activity usually involves the use of a denatured enzyme, or an enzyme replaced by an inert substitute. This is not the same as a controlled variable, as was frequently suggested.

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Question 2

(a) (i) Candidates were expected to measure the maximum length of five seeds in millimetres. Errors included measurements recorded in centimetres without changing the units used, recording an incorrect decimal, e.g. 25 mm as 20.5 mm, or the use of non SI units.

(ii) It appeared that some candidates were not familiar with the concept of tally charts. This lead to many tally tables that were not completed. It was incorrect to just record the five beans by the letters instead of tally marks.

(iii) Completion of the number column in the tally chart was achieved by most candidates, even those who had been unable to include the tallies for the five measured beans.

(iv) Most candidates presented the data as a histogram with labelled axes showing the ranges of maximum length and number of beans in each group, suitable size, accurate plots and columns that were drawn of equal width and in contact. The orientation of the columns was mainly vertical but some were presented horizontally. A few candidates confused the orientation of the columns with the labelling of the axes. Common errors in labelling of the axes included the omission of the units and the range of lengths for each category of 'bean length'. The scale was usually evenly spaced along the length of the axis, often with a sign below the first range category to show the discontinuity. Only a few candidates presented the numbers directly from the table in a non-linear scale in the incorrect order. Candidates need to construct the columns using neat, ruled lines; many histograms showed freehand, unevenly drawn columns. Few line graphs and bar charts were seen.

(v) The type of variation shown by the bean seeds was 'continuous variation' covering an overall range of 24.0 mm to 35.9 mm without gaps between the different lengths. Some candidates incorrectly recorded 'discontinuous' or did not attempt this part of the question.

(b) (i) The standard of drawings achieved by most candidates was high. A neat outline was used to show a complete bean, larger than the one shown in the photograph. Candidates should be reminded that if lines have to be erased, it is important that all traces of previous lines are removed. The detail of the radicle was generally shown quite clearly and in proportion to the size of the seed, but sometimes the outline of the plumule was not clear. The labelling was often omitted. The correct terms for parts of an embryo should be familiar to candidates; terms such as radicle were not always used. In order to construct an accurate image, it is important that candidates take time to draw the bean and not rush the observation of the details.

(ii) Most candidates accurately measured both the image in Fig.2.2 and their drawing. The majority showed either a line across the maximum length of their drawing or two vertical lines placed either side of the bean drawing to measure the maximum length in millimetres. Errors included measurements recorded in centimetres without changing the units used, recording an incorrect decimal, e.g. 95 mm as 90.5 mm or the use of non SI units. A few candidates measured the maximum width instead of length. Other candidates failed to show any indication of a line on their drawings. The formula to calculate the magnification was well known and applied by most candidates. Magnification does not have a unit; where units were included the answer was ignored.

(c) Most candidates were familiar with biuret test to show the presence of protein and the colour change involved. A common error was to omit the starting colour.

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Paper 0610/63

Alternative to Practical

Key Messages

It is vital that candidates read each question carefully and carry out the tasks required. The command words 'describe', 'explain' and 'suggest' each require a different type of response and frequently mark accessibility is limited in cases where the instructions have not been followed. It is also important that all the practical techniques named in the syllabus have been thoroughly covered during the course of study.

General comments

The majority of the candidates performed very well on this paper. This indicates that the candidates were both able and well prepared. The work was well presented and there were few problems with legibility of answers. Almost every candidate attempted all the questions and there was no evidence that timing had been an issue. As in previous examinations, some candidates would benefit by realising that if, for example, four marks are available for an answer, then four distinct points need to be made. There are some areas where specific improvements could be made and these will be clarified in the section on the relevant question.

Comments on specific questions

Question 1

(a) (i) Candidates were shown a photograph of an apple and a plum each cut in half. They were given information about the difference between the fruits in that the apple is a false fruit whereas the plum is a true fruit. The candidates were then asked to make a large, labelled drawing of the apple. The standard of the biological drawing was high and most candidates gained full marks. A few drew sketchy outlines or drew the fruit with a relatively thick skin. Rather more candidates lost the label mark as they either failed to label any structure, or their label lines did not end on the structure being labelled. Most candidates labelled the seed or the stalk of the fruit. Candidates were not expected to be familiar with labelling associated with fruit structure as this is beyond the scope of the syllabus.

(ii) Candidates were asked to calculate the magnification of their drawing. Most could measure accurately, but some candidates lost marks as they did not draw a line on their diagram or the measurements were given in centimetres (and units left as millimetres). A few candidates gave their measurements in inches, and though this was not penalised, it ought to be noted that the syllabus refers to the use of SI units for measurements. The majority of candidates were awarded the two marks for carrying out the calculation correctly, but a few lost marks because: the formula was inverted, incorrect rounding was used or units were given in the answer.

(b) (i) In this section, candidates were asked to give one similarity (other than shape) between the apple and the plum. The majority answered correctly, although some ignored the instruction and did refer to shape.

(ii) Candidates had to complete a table to state three visible differences between the two fruits. The most frequent mistakes were giving differences that were not visible (for example, describing differences in colour, texture, taste or juiciness) between the two fruits. Some candidates stated that the apple had many seeds or that the plum did not contain any seeds.

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(c) The test for a reducing sugar was well known and many candidates gained full marks. The most common reason for loss of a mark was failure to give the initial colour of the Benedict's solution. Other candidates did not apply heat during the test or omitted a safety feature. A few weaker candidates used biuret reagent or a solution of iodine in potassium iodide.

Question 2

This question was centred on investigations in which the enzyme trypsin was used to digest the white insoluble protein present in milk. Initially candidates were given a description of an investigation into the effects of changing the pH of the solution in which trypsin was working. The candidates were given the results for this investigation when carried out at two different temperatures.

(a) Candidates had to draw a graph of the results they had been given. Many excellent graphs were produced and candidates frequently gained full marks. The most common mistakes involved the axis where the pH number was given: either the scale covered the entire pH range or there was an inconsistency in the gradations of the scale. Inevitably, the latter frequently impacted on the accuracy of the plotting. Lines that were drawn free-hand often lost the line mark whereas ruled lines drawn point to point did not. Lines tended not to be extrapolated, although some had their origins at zero. A few candidates did not identify the two lines by temperature. Many candidates whose pH scale started at, for example a pH of 5, attempted to use the discontinuity sign, but did not know how to draw it correctly. This was not penalised, but candidates need to know the correct way to show this sign.

(b) (i) This required the candidates to use their graph to both describe and explain the effect of pH on the activity of trypsin. Many candidates had difficulty expressing their ideas. They tended to concentrate on either the description or the explanation and often attempted to describe the effect of temperature as well as that of pH. Some candidates gave accounts of enzyme activity in general, rather than using the information from their graph, whilst others gave detailed accounts of the action of trypsin in the digestive system. Most candidates realised that the activity of trypsin increased as the pH rose from pH 5.5 to 7.5, but then stated that pH 7.5 was neutral. The decrease in activity as the pH increased beyond 7.5 was less frequently noted. A common error was to state that the decrease in activity started at pH 8.

(ii) This section required the candidates to give a description of the effect of raising the temperature. The majority stated the increase in time / decrease in activity, but few went further than this (except to say that the enzyme was being denatured, but as an explanation was not asked for here, no marks could be awarded). Those that gained full marks did so by quoting figures from the graph to support their answer.

(c) (i) Most of the candidates knew why the reactants were placed in a water bath for six minutes prior to being mixed, but some had difficulties in expressing their ideas clearly. A few candidates thought that it was done to activate the trypsin or that the hot water would kill any bacteria present. A very few thought that the water bath was for washing the test-tubes.

(ii) On the whole, candidates were familiar with the use of, for example, a piece of text being placed behind the test-tube, whose clarity could be used to judge when the reaction was complete. Other candidates suggested using a comparator to determine when the trypsin had reached the end point. Only a few candidates suggested using a colorimeter. Answers for which no marks were awarded included repeating the experiment many times, having several candidates observe each result and using the same sized test-tubes.

(d) This section required candidates to consider a similar experiment to the first one, but in this case to investigate the effect of changing the temperature.

(i) Many gave a suitable range of temperatures to test, but a significant number used too narrow a range that did not extend beyond the two temperatures already given to them. A few mistakenly suggested starting at zero.

(ii) The majority of candidates answered this very well, often stating more variables to be kept constant than the two that were required.

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(iii) Many candidates gave the correct answer, but weaker ones tended to name a piece of measuring apparatus such as a stop watch, a thermometer or a measuring cylinder.

(iv) The nature of a control in an investigation was not known by candidates, even those who were very able. There appeared to be confusion between a control and a controlled variable. Very few candidates gave a correct response, the majority of these opting for the addition of boiled trypsin. A small number of candidates suggested carrying out the investigation in the absence of trypsin, but omitted to say that it should be replaced by water.

Question 3

This question was centred on the gases in inspired and expired air.

(a) Most candidates were able to complete the comparison table accurately, although slightly fewer were correct for water vapour than for carbon dioxide.

(b) (i) On the whole, candidates knew that lime water was a test for the presence of carbon dioxide, but the majority stated that the solution went milky / cloudy in its presence but did not state that the solution was initially clear and colourless. Weaker candidates referred to collecting the gas and testing it with a lighted splint.

(ii) Slightly fewer candidates knew a test for the presence of water vapour than knew the test for carbon dioxide. However, those that did know one of the tests usually quoted both the starting and end colours of a positive test. A large number of candidates gave various descriptions that involved droplets condensing onto a cold surface, but this is not a definitive test for water.

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