BIOLOGY

Paper 0610/11
Multiple Choice

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

General comments

The paper worked well to provide a meaningful challenge to candidates at this level. The most challenging questions served to expose some underlying uncertainties in candidates' minds, and, otherwise, all questions made a significant contribution to discriminating between candidates of differing abilities.

Comments on Specific Questions

Question 1

Most candidates answered this question correctly. However, some selected photosynthesis as the answer showing a misunderstanding of the process involved.

Question 6

Plant cell structure posed few problems for candidates. The presence of a cell wall in both diagrams was recognised by all candidates and with nearly all recognising chloroplasts in one cell and not in the other.

Question 9

The reference to transport as a function of xylem, appears to have been a distraction from the fact that the xylem is a tissue and not an organ. Some candidates therefore missed the fact that the xylem is a tissue used for support.

Question 11

This question proved challenging as many overlooked the fact that absorption in the ileum will occur by diffusion and that there is no form of gas exchange occurring in the bronchioles.

Question 12

Candidates should remember that digestion occurring in the stomach does so in strongly acidic conditions. Clearly they knew that enzymes are not sugars, but some also believed that *all of them* are most effective at pH7.

Question 15

This proved to be a challenging question as some candidates erroneously believed that the liver produces digestive enzymes.

Question 18

Some candidates showed a good understanding of the function of the phloem.

Question 22

Accommodation proved to be a particularly challenging concept for many candidates.

Question 24

Some candidates were thought that diffusion occurs in the umbilical cord rather than the placenta.

Questions 28 and 37

Were questions that demanded the ability to read information from a graph and candidates showed that this is a skill they have mastered, with a very high percentage of correct answers seen in both questions.

Question 30

The traditional confusion between meiosis and mitosis was seen, as was an uncertainty over the function of meiosis.

BIOLOGY

Paper 0610/12
Multiple Choice

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

General comments

The paper worked well to provide a meaningful challenge to candidates at this level. The most challenging questions served to expose some underlying uncertainties in candidates' minds, and, otherwise, all questions made a significant contribution to discriminating between candidates of differing abilities.

Comments on Specific Questions

Question 1

This demonstrated that the characteristics of living organisms is a topic that candidates know well.

Question 8

Most candidates were able to distinguish between a tissue and an organ, although a few thought that a root is a tissue.

Question 9

This question examined the topic of osmosis and many showed a good grasp of this process with only a few thinking that the cell would lose water.

Question 10

Candidates should recall that the partially permeable membrane in a cell is the *living* cell membrane, thus boiled cells will not be able to carry out osmosis.

Question 15

Candidates should ensure that they have learnt the initial colour of test reagents used for food testing so that they can correctly identify negative results for food tests. In this case yellow-brown as a negative test for starch.

Question 16

Candidates knew that water vapour that passes out through the stomata but not all realised that evaporation of water occurs inside the leaf. This made the question challenging for some.

Question 19

This proved challenging for some and required them to think carefully about the data presented in the diagram. Most candidates would certainly be able to state that there is less oxygen and more carbon dioxide in expired than in inspired air, yet some were unable to interpret the data given to arrive at the correct answer.

Question 22

The traditional confusion between liver and kidney function was evident in some response, where candidates believed that the kidneys break down toxins.

Question 23

Candidates should recall that the capillaries do not move away from the skin in cold conditions.

Question 24

A clear understanding of the function of the ciliary muscles was needed for this question. Being able to envisage a three-dimensional view may help candidates to understand this often-confused topic.

Question 27

The ability to read information from a graph is a skill that candidates have mastered and so this question was answered well.

Question 29

Candidates needed to understand the difference between haploid and diploid and meiosis and mitosis to correctly answer this question and this is traditionally a challenge for some.

Question 36

This question was generally well answered although some gave respiration as the process responsible for water loss from a tree. It cannot be denied that some of the water lost may have been released during the process of respiration, but it cannot be lost from the plant until it has evaporated.

BIOLOGY

Paper 0610/13
Multiple Choice

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

General comments

The paper worked well to provide a meaningful challenge to candidates at this level. The most challenging questions served to expose some underlying uncertainties in candidates' minds, and, otherwise, all questions made a significant contribution to discriminating between candidates of differing abilities.

Comments on Specific Questions

Question 1

Only a few candidates incorrectly thought that fish can maintain a constant body temperature and most were correctly able to identify the characteristics of fish.

Question 7

Candidates' knowledge of the differences between tissues, organs and organ systems was very good.

Question 8

Candidates showed a good understanding of the differences between animal and plant cells.

Question 11

Although many correctly identified that enzymes were responsible here, some chose hormones and perhaps had failed to appreciate that the question was asking about *metabolic* reactions, which are exclusively the province of enzymes.

Question 13

This question revealed an uncertainty over the nature of the glycogen molecule since, while most candidates were entirely confident that the basic molecule of starch is simple sugar, some felt that glycogen is made up of fatty acids and glycerol.

Question 21

The traditional confusion between liver and kidneys was evident here with some candidates believing that urea is produced in the kidneys.

Question 24

Candidates need to recall that the greatest rate of growth occurs on the shaded side of the shoot.

Question 28

The ability to read information from a graph is a skill that candidates have mastered and so this question was answered well.

Question 30

It was essential, before answering this question, to be clear about the difference between the terms meiosis and mitosis, haploid and diploid. This proved to be challenging for some candidates.

Question 35

This question was generally well answered although some gave respiration as the process responsible for water loss from a tree. It cannot be denied that some of the water lost may have been released during the process of respiration, but it cannot be lost from the plant until it has evaporated.

BIOLOGY

Paper 0610/21

Core Theory

Key Messages

A good recall of the definitions of key words, as defined in the syllabus, is essential.

Command words such as “describe”, “explain”, “suggest” and “compare” require different responses from candidates. A “suggest” question encourages the candidate to display biological knowledge linked to the learning outcome being tested.

If a description is required, including a reference to a graph or table, then it will be expected that data will be used in the description given. Many candidates are able to do this effectively. An explanation requires more than just a description and candidates should be encouraged to practise the difference between “explain” and “describe”.

Many candidates had clearly used or referred to past papers when preparing for this examination. It is always useful to practise past papers as some candidates have a good knowledge of biology but are unsure how to express themselves clearly.

General Comments

Candidates were able to complete all sections and there did not seem to be a problem with the time allowed for the paper.

Comments on Specific Questions

Question 1

Candidates showed a good understanding of how to use a key.

Question 2

Candidates need to have a good understanding of the structure and function of the skin and how it responds during thermoregulation.

(a) Some candidates gave excellent definitions. Many gave a specific definition, relating to maintenance of body temperature, rather than a general one.

(b) (i) Many were able to identify the hair and the sweat gland but less identified the receptors.

(ii) Candidates need to recall that arterioles will have the highest temperature on a cold day.

(c) (i) This question required a good understanding of how body temperature is lowered by vasodilation. Candidates should recall which vessels are able to dilate and constrict and which cannot, and how this relates to the loss of heat energy.

(ii) Many correctly linked sweating to evaporation and heat energy being used to achieve this. Some confused evaporation with transpiration and loss of substances other than water.

(iii) Some candidates managed to give one correct answer but few managed two. Some candidates focused on behavioural responses rather than the physiological responses that the answer required.

(d) A specific organ was required here rather than an organ system.

Question 3

Most candidates showed a good recall of the key word definitions required.

Question 4

(a) Candidates need to show a clear distinction between the terms growth and development.

(b) Candidates should only give the number of answers required which in this case was three.

Question 5

(a) This was well answered and a good knowledge of the male reproductive system shown. Candidates should take care with the spelling of key words. For example, testis and testa, urethra and ureter have similar spellings but are different structures.

(b) (i) Most candidates correctly identified the location of **X.**

(ii) Most candidates correctly stated the reason with only a few incorrectly suggesting prevention of STDs or production of sperm.

Question 6

(a) Candidates needed to recall the names of the blood vessels to and from the kidney very few were able to do so.

(b) The majority of candidates scored the mark for water but ions or salts, hormones and vitamins were also credited.

(c) (i) Urea is formed in the liver. Many candidates knew this information, however, a few wrote kidneys, intestine or pancreas.

(ii) Many knew that the production of urea was involved in the removal of toxic waste or excess substances but some found it difficult to express themselves clearly.

(iii) Some candidates seemed to confuse the circulatory and digestive systems.

Question 7

(a) (i)–(iv) Many candidates answer these questions well, with some showing only a limited understanding of the carbon cycle.

(b) (i) This question was answered correctly by most candidates.

(ii) Candidates need to learn the word equation for aerobic respiration and realise how it differs from photosynthesis.

(iii) While many candidates know the reactants and products of respiration, less are able to explain the purpose of it. It is also important that candidates understand what the energy released is used for.

Question 8

(a) Many realised the need for digestion before nutrients can be absorbed and used by the body but few clearly expressed their answers in terms molecules needing to be small enough to be absorbed. Many answers commented about needing to digest food to separate the useful from the unwanted parts.

(b) This question was generally well answered but sometimes incorrect words were used, e.g. long or thick intestine instead of large, and thin instead of small.

(c)(i) Most calculated the answer correctly.

(ii) Careful reading of the question was important and candidates were required to discuss absorption rather than digestion in this question. Some identified that data from the table could be used to support their answer.

Question 9

(a) This standard definition was known by some candidates. It is important that water vapour is mentioned not just water. Some candidates seem to confuse sweating and transpiration and answered in terms of humans.

(b) Some candidates answered in terms of the causes of wilting rather than preventing further wilting by changing the environment.

Question 10

(a) Some candidates described rather than named the phases.

(b) (i) Some candidates stated the difference but did not go on to explain the difference.

(ii) Many candidates were able to correctly identify the social implications associated with the size of the human population, but some did not seem familiar with this term from the syllabus.

BIOLOGY

Paper 0610/22
Core Theory

Key Messages

It is important that candidates read the instructions carefully and carry out the tasks required. As stated in the report last year, the command words “describe” and “explain” require different responses, and this needs to be reinforced to candidates. It is also useful for candidates to look at the mark allowance for each question; when a question carries three marks it indicates that three distinct points are required in the answer.

General Comments

There were some excellent scripts seen with some candidates performing very well. The paper contained some rigorous elements and these served to differentiate between candidates. There was also a wide range of question type and question demand, so that all candidates were catered for and all had the opportunity to display their knowledge. There was no evidence that candidates lacked sufficient time.

Comments on specific questions

Question 1

The technique of using a key for identification was well known and candidates performed well. Only a very few appeared not to have used a key previously. The most common error was to confuse the butterfly and the moth.

Question 2

(a) (i) Many candidates associated an increased body temperature with the vasodilation illustrated in the diagram.

(ii) Many candidates gained a mark for “sweating”. This describes the response asked for, but does not explain it. Few could explain why sweating cooled the body.

(iii) Few showed a good understanding of mammalian characteristics. Maintenance of a constant body temperature is an important feature in mammals. Some candidates, who were aware of this, thought that the blood somehow gained heat by travelling near the surface of the skin.

(b) Many candidates identified 33 °C as the temperature at which subjects were said to be hypothermic. However, some seemed unclear about the difference between hypothermia and hyperthermia.

(c) Few candidates wrote an answer that referred to muscle contraction, respiration and the release of heat energy. The most usual answers described other changes that occurred during exercise such as an increased breathing rate and increased heart rate.

Question 3

(a) (i) Few candidates inserted the arrow correctly.

(ii) The blood vessels were not identified, with the majority merely stating vein or artery. Few could supply the specific names.

(iii) Some candidates could draw the route for the hepatic portal vein, and some knew its name, but few knew both the name and the route.

(b) Most candidates were able to complete the table.

(c) (i) The coronary artery was poorly recognised.

(ii) Most candidates could state a substance that might be responsible for the blockage.

(iii) Some explanations lacked clarity. In many answers candidates seemed to think that the blood flow into a heart chamber was blocked, and not the blood flow to the heart muscle. Some candidates just described the symptoms of a heart attack rather than answering the question.

Question 4

(a) Linking definitions of processes with their names was carried out competently in most cases.

(b) (i) Very few candidates could correctly define the term mitosis.

(ii) The most frequent response was to repeat the "repair " idea given in the stem or to give an example of where this might take place, such as in healing a cut in the skin.

(c) Candidates were more familiar with this topic and there were some good answers, although some did not write the letter **M** on the diagram for part **(iii)**.

Question 5

(a) This area of the syllabus was not well known and relatively few candidates could identify the type of tooth or label it accurately. The label usually given correctly was the root. It should be noted that the term "pulp cavity" can be misleading as it is packed with cells and is not, as the name might suggest, hollow.

(b) The mark most frequently awarded was for the idea that eating too many sugary foods, not brushing the teeth and not visiting the dentist are all contributory factors in tooth decay. Many candidates could state that bacteria were involved in the decay process, but only some could describe anaerobic respiration and the formation of acid with subsequent erosion of the tooth enamel. A common misconception is that bacteria "eat" the enamel and the rest of the tooth.

Question 6

(a) Many candidates could interpret the graph and give the age at which the head gained its full size. Fewer could give two age ranges when the growth of the whole body is rapid. Ages between 14 and 20 years were given accurately, but the fact that there is also rapid growth during childhood was appreciated by relatively few.

The third section of part **(a)** was more challenging, few answers gave a full explanation which included the role of the sex hormones.

(b) Most candidates associated a deficiency in calcium in the mother's diet with weak bones in the fetus which was credited. It should be noted that the fetus receives all the calcium it needs by depleting the calcium in the mother's bones if necessary.

It is a common misconception amongst students that if a mother smokes during pregnancy, the baby, when born will suffer from a lung disease or from cancer when in the baby would have a lower birth weight than normal, or brain development would have been affected adversely.

Question 7

(a) (i) This was well answered by most candidates. The most frequent error was to put "egestion" instead of "decomposition".

(ii) The word equation for respiration was not widely known. Many candidates did not know the products of the reaction.

(iii) Some candidates gave a good account of eutrophication. Others could describe run-off into rivers followed by a consequence of this, but lacked understanding of the sequence of events.

(b) The effects of deforestation were well known and many candidates wrote good answers. There were a large number of points that could be made and most candidates could think of at least two effects that would harm the environment. The impact of their being less photosynthesis needs to be emphasised. The resultant increase in the levels of atmospheric carbon dioxide leads to increased global warming. The slight reduction in the levels of atmospheric oxygen has relatively little impact on the environment. Many candidates appear to think that animals in deforested areas cannot survive as there is too little oxygen available. This is a misconception that needs to be addressed.

(c) (i) Many candidates carried out the calculation accurately.

(ii) The answers to part (ii) were often imprecise. The word “germ” should be avoided and needs to be replaced by, for example, bacteria or other scientifically appropriate terms. Reference to “wastes” was not acceptable as a named waste was required. A distinction needs to be made between a disease and the pathogen which causes that disease.

(iii) Many candidates stated vitamin C correctly.

Question 8

(a) (i) Few candidates recognised and named the villus.

(ii) More candidates could state absorption of nutrients as a function for the villus than could name the structure. Some mistakenly thought that the villus helped to move the semi-digested food along the ileum.

(b) Many completed the table correctly.

(c) There were many answers that discussed general functions of the liver rather than the specific aspect of protein digestion that was required.

BIOLOGY

Paper 0610/23
Core Theory

Key Messages

Candidates should read each question and ensure they follow instructions carefully, particularly when directed to use data in their answers.

General Comments

There was a good understanding of the command words: suggest, describe and state. This gives the opportunity for candidates to fully demonstrate their knowledge and understanding. Some candidates were unclear of how to answer a "define" question, giving information about the subject rather than its definition.

Comments on Specific Questions

Question 1

This question about keys was attempted by all candidates and very few errors were made.

Question 2

This question, in all its parts, dealt with transpiration. Candidates understood the flow of water out of the leaf, but did not fully describe the mechanism or include water vapour in their answers for **(a)**. Question **(b)** was answered well. Full marks could have been obtained if they had related surface area to more stomata. Candidates clearly used the information given in the diagrams, for their answers for **(c)(i)** and **(c)(ii).** While they understood the need for controls in experiments, they did not understand how to control water loss.

Question 3

This series of questions was generally well answered, but candidates need to develop their answers. In **(a)(iii)** sufficient detail of the form of waste or nutrient was required, for example nutrients such as glucose, vitamins or amino acids.

Candidates tried hard to describe changes at birth for part **(b)** and described the part (e.g. cervix) if they did not know the name. Where boxes are supplied for the answer, it is acceptable to continue below if there is not enough space.

Candidates should have noticed that there were four marks for part **(c)** and should therefore have made four points in their definition. Although most answers were correct, explanations were insufficient.

Part **(d)** showed that candidates can read and interpret graphs.

Question 4

This question was not looking at the effect of humans on species and their habitat, but rather why humans need to conserve i.e. why it is important to humans. This was not understood by most candidates, so although they demonstrated an excellent understanding of human effects on species and habitat, they did not answer the question.

Question 5

An excellent understanding of these terms was shown.

Question 6

Candidates need to become familiar with a range of different seeds. Few were able to draw both the plumule and the radicle emerging from the broken seed-coat. Many drew these structures originating at the top of the bean seed. Most candidates were familiar with phototropism, less so with the response to gravity.

Question 7

Part **(a)** dealt with the heart itself. Most candidates were familiar with the structures of the heart, although many did not correctly name the valve. While most candidates understood that the thick wall of the left ventricle is related to blood pressure and distance, not all realised that it is the muscle creating the pressure, rather than withstanding the pressure of blood sent to it.

There is an excellent understanding of the importance of valves in maintaining a one-way flow of blood. Very few candidates were able to extend this to explain how the pressure created by contraction of the heart muscle forced the blood in one direction.

Naming of blood vessels for part **(b)** was generally not well answered. Candidates need to memorise the words associated with the different organs e.g. hepatic for liver.

Most candidates managed to complete the table 7.1 correctly for oxygen, but not for urea. This may have been because they thought the blood flow through the kidney was in the other direction or because they were unclear where urea is produced.

The interpretation of data for part **(c)** was excellent.

Question 8

Most candidates demonstrated a good understanding of these terms, although few knew that controlling body temperature was part of homeostasis. Some candidates confused vasodilation and vasoconstriction.

Question 9

Candidates showed a good understanding of populations but often found it difficult to describe what was happening. In **(a)i** nearly all candidates were able to give at least part of the definition, with very few only describing things that might affect a population.

In question **(a)ii** three different factors were needed, but sometimes these were specific to humans or too general, such as resources.

Few candidates knew the correct names for the stages on a bacterial growth curve for **(b)i** or what happened during the death phase for **(b)ii** and therefore few were able to compare the curves for **(b)iii** adequately.

BIOLOGY

Paper 0610/31

Extended Theory

Key Messages

- Candidates should always pay close attention to the command words in questions, especially when they follow data in the form of graphs and tables. The distinction between describe and explain was not clearly demonstrated by some candidates. This was noticeable in **Question 2**, **Question 4** and **Question 5**.

- The syllabus includes several definitions of key terms. **Questions 1(d)(i)** and **Question 4(a)** asked for definitions of meiosis and tissue respectively. Many candidates gave the syllabus definitions, but many did not. Candidates are advised to revise these definitions thoroughly. Some of these definitions have been revised slightly in the new syllabus.

- The working for calculations should always be shown as credit is given if the answer is incorrect but a key step in the calculation is shown correctly.

- Candidates should be encouraged to use the correct scientific terminology. A number of candidates used terms such as ‘messages’ for impulses and ‘water concentration’ when water potential should be used and the ‘production of energy’ instead of the release or transfer of energy.

General Comments

Candidates generally confined their answers to the permitted space on the paper. This was good to see as, hopefully, this meant that responses were direct and included fewer contradictory statements. It appeared as if all candidates had time to complete the paper.

Negative feedback is a concept that candidates are required to explain. It can be a difficult term to define and to explain without the use of an example. In this paper the role of negative feedback in the control of body temperature was tested. In answering this question it is a good idea to state that the body temperature is kept constant, near constant or within narrow limits. Negative feedback mechanisms do not operate unless there is a fluctuation of the physiological parameter involved.

Comments on Specific Questions

Question 1

Almost all candidates followed the key correctly to identify the organisms within the group Reptilia. The correct use of terminology was not always apparent in the other part questions.

(a) (i) Almost all the candidates recognised the organisms as reptiles. A few suggested that the group was the amphibians.

(ii) Most candidates were able to complete the key correctly to gain full credit. A few candidates put letters in all the spaces in the key.

(b) The candidates generally understood that lizards are part of food chains and webs and that these feeding relationships would be disrupted if lizards were to become extinct. Many recognised the importance of maintaining biodiversity and the possible role of these animals in future research.

(c) (i) Whilst candidates did not generally comment on the example of the Komodo dragons given in the question, they were able to use their understanding of asexual reproduction to give some sound disadvantages of this method of reproduction. General points were accepted as well as references to the process in plants or even bacteria. The most common answers were the production of identical offspring and reduction in genetic diversity. Many recognised that unfavourable characteristics would be passed on and that there would be less chance of the species evolving. Many recognised that the products of asexual reproduction had 'less chance of survival', but failed to qualify this by adding 'in a varying or changed environment'.

(ii) Candidates were asked to state two disadvantages of sexual reproduction. The most common answers were that two individuals are required and that the process is slower than asexual reproduction. A few candidates provided excellent answers showing understanding of how the inheritance of recessive characteristics could result in organisms less able to adapt to changes in the environment. However, candidates should know that this is not universally true. There are many examples of organisms possessing recessive characteristics that are common because they are adaptive.

(d) (i) Candidates understood that meiosis is a reduction division and very little confusion between meiosis and mitosis was seen. Most noted the production of haploid cells, but needed to state that the division was from diploid to haploid. A common error was to state that meiosis was the 'division of gametes'.

(ii) This question caused some difficulty with few candidates able to go beyond the idea of meiosis producing gametes that then allowed reproduction. It was expected that candidates would show understanding that meiosis is a cause of variation in gametes, and hence offspring, which then leads to competition and to natural selection.

Question 2

(a) (i) This calculation required candidates to use the *x*-axis of the trace to determine the duration of one or two breaths and then convert the figure into breaths per minute. The calculation was 60 divided by 5 to give 12 breaths per minute. Some candidates stated that there were two breaths in eleven seconds because they did not notice that the first breath started at one second.

(ii) The trace showed a very clear difference in the two patterns of breathing. Credit was given for comparison of the breathing rate and the depth of breathing and the increase of lung pressure. Values from the graph were not expected. Often reference was made to the need for extra oxygen or energy during the match, without stating that this is reflected by the increase in the rate and depth of breathing and linking it to the altered pattern.

(b) Many candidates achieved full credit on this question. However, there was a lack of detail in some answers. No credit was given to answers that described the route taken by air from the atmosphere down the trachea and bronchus to the lungs. The process of inhalation involves the contraction of the diaphragm and the external intercostal muscles, the relaxation of the internal intercostal muscles and the decrease in air pressure inside the lungs. A few answers incorrectly implied that the expansion of the lungs causes the movement of the diaphragm and rib cage.

(c) (i) Carbon dioxide is a waste product of respiration or metabolic waste. Many answers stated that an excretory product is just a waste product. Candidates should be clear of the differences between excretion and defecation. Some candidates recognised that carbon dioxide is toxic if it accumulates in the body.

(ii) This question asked for the part of the blood in which most carbon dioxide is transported. Most carbon dioxide is carried in the plasma with some carried inside red blood cells.

(iii) An increase in the carbon dioxide concentration in the blood lowers or decreases the pH of the blood, making it more acidic. Many candidates gave the correct answer.

(d) The relationship between more carbon dioxide and more respiration seemed well understood. Fewer candidates commented on the steeper concentration gradient that would occur and lead to increased diffusion. A high rate of aerobic respiration gives rise to high concentrations of carbon dioxide in the blood vessels surrounding the alveoli. This leads to a steeper diffusion gradient between the blood and alveolar air and therefore a greater rate of diffusion of carbon dioxide out across the alveolar wall.

Question 3

(a) This part proved challenging for some. To achieve the marks, candidates had to name and give the appropriate letter of the skin component identified by the responses to cold weather in Table 3.1. The sweat gland (U) was often misidentified an arteriole (T). Candidates often stated that capillaries constrict rather than giving arterioles as the answer in the second row.

(b) Involuntary actions were generally understood and the Examiners saw most of the points included in the mark scheme. The most common idea given was that ‘involuntary action does not require thinking’. Many candidates who referred to the speed of responses and the probable protective nature of those responses scored highly. Very few mentioned the role of glands as effectors.

(c) Candidates were asked to describe how the nervous system coordinates the response of the skin to cold weather. The best answers included a description of the passage of nerve impulses from temperature receptors in the skin to effectors to stimulate muscle contraction in the shivering response. Credit was not awarded for descriptions of the skin in either cold or hot conditions. Some candidates used the term ‘messages’ instead of impulses.

(d) The explanation of negative feedback proved challenging to some. Credit was earned for the idea that the body coordinates actions to reverse any change of temperature and that this will result in a return to the normal or optimal body temperature. Very few noted that a change in temperature acts as a stimulus. Only a few answers mentioned homeostasis.

Question 4

(a) There is a definition of the term *tissue* in the syllabus. Many candidates did not define this term accurately, either missing the point that the cells are similar in structure or that they work together to achieve their function.

(b) (i) Most candidates recognised that tissue **A** was spongy mesophyll.

(ii) The majority of candidates stated that gases travel through the stomata by diffusion.

(c) Candidates needed to observe the photograph carefully to answer this correctly. The cell labelled **B** is a cell from the palisade mesophyll. Although actual identification was not required it appeared that all the candidates knew this. The question asked how the cells differed and differences in structure were expected, e.g. 'cell **B** has many chloroplasts not seen in root hair cells'. Some candidates concentrated on differences in function of the two cells.

(d) Careful reading of the question was essential as some responses contained many details of how water enters the root when the question required candidates to outline the events occurring after this point. It was expected that answers should include passage through the xylem, movement into the leaf by osmosis and evaporation from surfaces of mesophyll cells. Exit from the stomata was not credited as the question only asks for how the water reaches the stomata.

(e) (i) Correct observation of Fig. 4.1 allowed candidates to make accurate comparisons between the leaf hairs on the upper and lower surfaces of the leaf.

(ii) A sizeable group of candidates believe that plants can obtain water through their stomata and use this water for photosynthesis, and that plants require high humidity to cool down. Better answers included reference to a reduction in transpiration and therefore less water loss.

Question 5

(a) The majority of candidates identified the type of pollination correctly as wind pollination. Feathery stigma, large anthers and anthers hanging outside the flower were the most common points given in explanation.

(b) Cross pollination was identified by most of the candidates.

(c) Structure **B** on Fig. 5.1 was identified correctly by many candidates, but even those who could not name it knew its general function.

(d) Candidates were asked to describe what happens at fertilisation in flowering plants. It was expected that candidates would state that the ovum and the male nucleus delivered by the pollen tube fuse together to form a diploid zygote. In some cases incorrect use of specific terms were often barriers to achieving full marks.

(e) All the parts of this question were answered correctly by many candidates by giving the following answers: **(i)** ovule and **(ii)** ovary (wall). The most common correct answer to part **(iii)** was the colonisation of new areas.

(f) Most candidates were aware that enzymes are involved in respiration and that stores of carbohydrate, lipid or protein within the seed must be broken down to allow germination. Some candidates were able to provide specific examples of enzymes and state their roles during germination. Amylase and the breakdown of starch were the most common. Candidates who wrote 'starch stored in the seed is broken down by amylase' earned full credit.

Question 6

(a) (i) The answer to the calculation is 48.9%, but candidates were asked to give their answers to the nearest whole number so only 49% gained full credit. Those candidates who showed their working but who did not round up their answer gained partial credit.

(ii) Good responses seen included: 'less paper was used', 'other materials are replacing paper' and 'more information is distributed electronically, not relying on paper'.

(iii) Candidates needed to consult the Table 6.1 to find the answer to this question. There were only two possible correct answers – green kitchen waste and glass. Some candidates did not read the question carefully and thought of other materials that could show the same trend.

(b) The details of paper recycling were not well known. Candidates that did know about the process often omitted deinking from the sequence of stages that they described.

(c) Candidates were asked to consider the consequences of an increase in greenhouse gases in the atmosphere. Almost all stated that global warming was one such consequence. The environmental effects of global warming, such as extreme weather conditions and the melting of glaciers, were often quoted. Few candidates gave positive effects as they did not point out that an increase in the carbon dioxide concentration would lead to an increase in photosynthesis and higher yields of crops. Candidates should be careful not to confuse the effects of greenhouse gas emissions with other forms atmospheric pollution such as ozone destruction by CFC's and the formation of acid rain.

BIOLOGY

Paper 0610/32
Extended Theory

Key Messages

- Candidates should always pay close attention to the command words in questions, especially when they follow data in the form of graphs and tables. The distinction between describe and explain was not clearly demonstrated by some candidates. This was noticeable in **Question 2**, **Question 4** and **Question 5**.
- Similarly, they should read instructions carefully so that they answer the question asked.
- There are some biological terms that are easily confused if misspelt. Examples seen included meiosis and mitosis, fission and fusion, glycogen and glucagon. Candidates must use the correct spelling of these words to avoid ambiguity.
- The syllabus includes several definitions of key terms. **Questions 1 (c)(ii)** and **(iii)** asked for definitions of diploid and development respectively. Many candidates gave the syllabus definitions, but many did not. Candidates are advised to revise these definitions thoroughly. Some of these definitions have been revised slightly in the new syllabus.
- Explanations of the effect of exercise on the body often require candidates to state that there is an increase in muscle contraction, an increase in the demand for energy and therefore and increase in the rate of respiration. Often the word 'more' used several times is sufficient to convey the right ideas, but sadly it is often omitted and the idea that there is an increase in these aspects of physiology is not conveyed at all.
- Candidates should be encouraged to use the correct scientific terminology. A number of candidates used terms such as 'messages' for impulses and 'water concentration' when water potential should be used and the 'production of energy' instead of the release or transfer of energy.
- The working for calculations should always be shown as credit is always given if the answer is incorrect but a key step in the calculation is shown correctly.

General comments

It appeared as if all candidates had time to complete the paper.

Negative feedback is a concept that candidates are required to explain. It is a difficult term to define and to explain without the use of an example. In this paper the role of negative feedback in the control of blood glucose concentration was tested. However, some candidates lost sight of the question and just described the control of blood glucose concentration without explaining how negative feedback is involved. Many did not state that the blood glucose concentration is kept constant, near constant or within narrow limits. Negative feedback mechanisms do not operate unless there is a fluctuation of the physiological parameter involved. Candidates should be reminded that the hormones that cause the changes in blood glucose concentration do not act as enzymes.

The questions providing the most discrimination were **Question 4 (c)(ii)** which asked for detailed explanations to account for the differences between the distribution and density of stomata of the two named species, and **Question 6 (c)** that asked for the advantage of using indicator species in studying freshwater ecosystems.

The responses to **Question 6 (c)** show the importance of preparing candidates to practice answering questions that require the interpretation of ecological data.

Comments on specific questions

Question 1

(a) Feathers was the only accepted answer. Some candidates gave wings and beaks even though the question excluded these features. The most common error was to give 'scaly legs' as the feature that was unique to birds. Candidates should know that reptiles also have scaly legs. Another common error was 'scales and claws'.

(b) Most candidates completed the identification key correctly. A few candidates put letters in the shaded boxes and none in the unshaded boxes, suggesting that they did not understand the instructions and were unfamiliar with using a key. The last two answers in the key were G and B, but these were occasionally reversed.

(c) (i) A common error was to give two processes, so meiosis and fertilisation were common answers rather than meiosis and zygote. A significant number of candidates gave 'ejaculation' and 'ovulation'. Mitosis was a common incorrect answer.

(ii) Candidates often struggled with defining the term diploid in the context of cell **B** (zygote); few gave the simplest answer which is that the cell contains two sets of chromosomes. Some referred to the fusion of two haploid cells, although they often stated that the diploid cell *contains* two haploid cells. Simply giving the number (80) or stating that 2n = 80 was not sufficient. Many candidates gained credit by stating that a diploid cell was the result of the fusion of 40 chromosomes from one parent and 40 from the other.

(iii) Some candidates confused definitions of development with definitions of growth.

(iv) The required response identification of the advantages to the species rather than to individual members of the species. Explanations of the advantages of variation proved challenging, although many conveyed acceptable ideas such as adaptation to new environments, evolution and natural selection, increasing chances of survival and reducing chances of extinction. A few candidates mentioned the idea that variation may reduce competition between members of the same species. Candidates frequently stated that variation allows adaptation to the environment, rather than stating that it allows adaptation to *changes* in the environment, an idea that was often expressed in a variety of different ways. Most candidates gave an example of a characteristic which could be advantageous such as having resistance to a disease.

Question 2

Answers to the part questions revealed that candidates often did not follow the command words, especially in parts **(a)(ii)** and **(iii)**. Many of the descriptions in part **(a)(ii)** were very well written with good use of the data in the graph in Fig. 2.1. It was good to see data quotes taken accurately and units included. Many candidates were not successful at the calculation in **(b)(i)** as they were, perhaps, not expecting an answer greater than 100%. Parts **(a)(iii)** and **(b)(ii)** prompted excellent explanations of anaerobic respiration, although they were only relevant to **(b)(ii)**. Candidates were not as fluent in explaining aerobic respiration as they were anaerobic.

(a) (i) Some candidates did not read the scale correctly on the graph giving answers such as 4, 4.04 and 4.2 instead of 4.4 ($cm^3\ kg^{-1}\ min^{-1}$).

(ii) Some answers gained full credit without quoting any figures from the graph. They did this by describing the overall pattern and, often, stating that the uptake of oxygen returned to the value at the start or at rest. Those who gave data quotes usually included the correct units although there were many who did not. Credit for use of figures taken from the graph was only awarded if the full unit was given. Recognising the very rapid increase in oxygen uptake at the start of the exercise and the more gradual decrease after completing the exercise was rarely described. The common error here was to explain rather than to describe the pattern.

(iii) A few candidates repeated their answers to part **(ii)** with slight variations when explaining the uptake of oxygen during the exercise. Many candidates gave the expected explanations, but often referred to *anaerobic* respiration, lactic acid and oxygen debts instead of explaining why the

oxygen uptake increased and stayed constant for the duration of the run on the treadmill. One of the expected answers was that by increasing oxygen uptake anaerobic respiration was either prevented or kept to a minimum although only a few candidates made this point. Many did not state that during exercise there is an increase in muscle contraction so increasing the demand for energy and an increase in the rate of respiration. They simply stated that muscle contraction occurs and seemed to forget that muscle contraction and respiration occur all the time. Many also stated that the decrease was due to anaerobic respiration taking place. Although many identified that the heart beats faster and more oxygen was needed this was often not linked to the increase in muscle contraction occurring at the time.

(b) (i) Some candidates chose incorrect ways to calculate the percentage increase in the concentration of lactic acid. Instead of calculating the increase (170 mg dm^{-3}) as a percentage of the original (100 mg dm^{-3}), they calculated the increase as a percentage of the final concentration (270 mg dm^{-3}) arriving at the answer 63%. A few calculated '170' and then subtracted another 100.

(ii) The explanations for the greater increase in the concentration of lactic acid were generally very good. Almost all candidates knew that insufficient oxygen reaches the muscles to supply aerobic respiration so that anaerobic respiration occurs producing lactic acid. Very few stated that lactic acid diffuses from the muscle into the blood so accounting for the increase in the concentration in the blood. Errors here included the misconception that lactic acid provides the energy for running at the higher speed.

Question 3

This question tested knowledge of the human digestive system from **Section III** of the syllabus. The answers to parts **(a)** and **(b)** were much better than those on the control of the blood glucose concentration in **(c)** and **(d)**.

(a) (i) Many candidates identified the three regions of the alimentary canal. Common errors included labelling the oesophagus (G) as the trachea and the diaphragm (H) as the ribs.

(ii) There were many successful answers that identified the correct organs from their functions in Table 3.1 and stating the appropriate letter from Fig. 3.1. Common errors were to name the bile duct as the organ that stores bile, state that the liver is the site of chemical digestion of protein and name L (the ileum) as the duodenum or large intestine.

(b) (i) Many candidates identified the process depicted in Fig. 3.2 as emulsification. Common incorrect answers for this question were 'digestion', 'assimilation' and 'absorption'.

(ii) There were many very good answers that explained that emulsification increases the surface area of the fat so that lipase acts more effectively. Emulsification is not the chemical digestion of fat as the molecules are not broken down into fatty acids and glycerol although some candidates gave this as their explanation. Some candidates wrote about fats 'blocking up arteries' and causing heart attacks which were not accepted.

(c) (i) Common errors included giving the same response for each hormone; for example, candidates stated that insulin increases the uptake of glucose by cells and therefore increases the concentration of glucose in the blood. They then gave 'decrease' as the response in both cases for glucagon. Many candidates reversed the answers here giving the correct effects of glucagon in the row headed 'insulin' and the correct effects of insulin in the row headed 'glucagon'.

(ii) Adrenaline was the most common correct answer to this question asking for the name of another hormone that influences the concentration of glucose in the blood. Some candidates gave hormones secreted by the adrenal cortex and a few gave thyroxine, all of which were accepted. Incorrect answers included oestrogen, ADH, testosterone and glycogen.

(d) The most successful responses explained that the concentration is kept constant, or within certain limits, and that the pancreas secretes hormones that stimulate the liver to restore the concentration if it increases and decreases beyond those limits. A few stated that this is an example of homeostasis and gained credit. A frequent error was to answer the whole question with a description of the corrective action only. Candidates who did this described the action of insulin and

then described the action of glucagon without referring to negative feedback. Few candidates knew that a hormone would be switched off once its action had taken effect.

Question 4

This question examined gas exchange in plants and the distribution of stomata on leaves as examples of the adaptations of a hydrophyte and a xerophyte. Part **(c)** proved to be a good discriminator as candidates had to analyse the data for three plant species and then give explanations for the distribution of stomata on leaf surfaces.

(a) Almost all candidates identified the cells labelled on Fig. 4.1 as guard cells. Some misread the question and called them 'stomata'. Others stated that they were epidermal cells or plant cells, which was not precise enough.

(b) (i) Full credit for this question on oxygen release from plants during the day was often gained by stating that oxygen is a product of photosynthesis that increases in concentration inside the leaf and diffuses into the air down its concentration gradient. The very best answers explained that some of the oxygen is used in respiration and during the day oxygen diffuses out because the rate of photosynthesis is greater than the rate of respiration. Many candidates gained limited credit for simply stating that oxygen is produced during photosynthesis. Some candidates interpreted the question as requiring more about the light available to the plants rather than about the diffusion of oxygen from the leaves to the atmosphere. The most common misconception was that plants do not need oxygen. Few referred to the fact that during the day photosynthesis was proceeding faster than respiration, consequently more oxygen was being produced than was being used resulting in the gas being released from the plant. Many, however, did state that the gas would pass out of the leaf by diffusion down a concentration gradient.

(ii) There were many good answers that described the pathway of carbon dioxide in the reverse direction to oxygen. The most common answer was through air spaces in the mesophyll to chloroplasts in the palisade cells where carbon dioxide reacted with water in photosynthesis. Weaker candidates tended to perform better on this question than on **(b)(i)**. Details of the reactions of photosynthesis were not expected, but the very best candidates often referred to these sometimes with details appropriate to A level. Very few explained the uptake across the cell membrane and into the cytoplasm. Many candidates gave good descriptions of the role of carbon dioxide in photosynthesis, and the importance of chlorophyll; unfortunately, this was often at the expense of giving a description of the route taken by the carbon dioxide, which was what the question required.

(c) (i) In answer to this question on stomatal density in three species, the best responses stated that annual meadow grass has the lowest density and has stomata on both surfaces of the leaves. Copying the numbers from the table without any words of comparison and without stating that the numbers are the mean number of stomata per mm^2 of leaf surface did not gain credit. Some referred to the overall surface areas of the leaves which was not relevant to the question. The concept of mean stomatal density was not understood by some candidates who wrote about 'mean stomata'. Others wrote statements such as 'the common myrtle had density in the epidermis' showing that they did not understand the information provided in Table 4.1. Quite a few candidates interpreted the table as showing that the common myrtle lacked an upper epidermis and the white water lily lacked a lower epidermis.

(ii) This question proved challenging for some candidates who did not relate the results in the table to the habitats of the water lily and common myrtle. A significant number of candidates were unable to give any explanation for the differences in distribution and density of stomata in the white water lily and common myrtle. Many answers to this question did not mention stomata**.** Those who used the information in the table often explained that water lilies gain all their carbon dioxide and oxygen from the air through stomata on the upper surface. The very best explained that diffusion of carbon dioxide and oxygen is much slower in water than in air so it is advantageous to have all stomata on the upper epidermis. The role of stomatal distribution in controlling water loss in common myrtle was generally better answered than the reasons for stomatal distribution in the water lily. Many used the information in the table to base their explanations on the habitat of both species. However, candidates did not often state that in the case of the water lily, the presence of stomata on the upper epidermis permitted more efficient gaseous exchange as this surface was in contact with the air. Few failed to mention that the water lily has large numbers of stomata in the upper epidermis as water loss by transpiration was not significant.

More candidates, however, did realise that transpiration was significant in the habitat of common myrtle and having stomata on the lower epidermis reduces water loss. Candidates were not credited for stating that transpiration would be prevented rather than restricted.

Question 5

(a) (i) Many candidates gave good answers to this question. Some candidates thought that it was the agar that was growing and said that glucose provided energy for agar and that amino acids helped it grow. A few candidates thought that glucose was needed to make starch and that amino acids were needed to breakdown protein.

(a) (ii) Some candidates stated that bacteria divide by mitosis or, more rarely, by meiosis. Some wrote about 'binary fusion' rather than binary fission. The inclusion of mitosis did not disqualify answers that included binary fission. Candidates should know that mitosis is a type of nuclear division that occurs in eukaryotes and it does not occur in prokaryotes. Some candidates realised that bacteria reproduce asexually, but thought that they could do this by one bacterium making gametes. Bacteria are not self-fertilising hermaphrodites. Some candidates confused bacteria with fungi and wrote about spores, hyphae and mycelia.

(b) Some candidates misinterpreted this question as 'describe' rather than 'explain' and some confused 'antibiotics' with 'bacteria'. Many simply described the two plates rather than explain why there were so few colonies on plates 3 and 4. Despite a reference in the diagram, some candidates thought that the circles in the Petri dishes represented individual bacteria. Better answers referred to the antibiotics killing many bacteria except for those that were resistant. Few candidates explained that fewer bacteria were resistant to antibiotic **T** compared to those resistant to antibiotic **S**.

(c) Most candidates referred to the reproduction of the bacteria accounting for the larger number of bacterial colonies on plates 5 and 6, but missed the point that they were all genetically identical as a result of reproducing asexually. Only a small proportion made it clear that only resistant bacteria were taken from plates 3 and 4 to be cultured in the growth medium for 24 hours.

(d) Some candidates appreciated that there were two strands to answering this question. They used the information from the earlier questions to explain that bacteria gain resistance as a result of mutation and survive in conditions that kill all non-resistant bacteria. Candidates often answered in the context of people not completing courses of antibiotics. They then described how they reproduce and how they spread from one host to another. Few candidates developed their answers by discussing the effects of mutations in causing a change in a gene and how this might lead to resistance. The question did not specifically ask about *Neisseria gonorrhoeae*, so the Examiners accepted any form of transmission from host to host. Some candidates thought that transmission was within the same person rather than from one person to another. Some candidates interpreted this question as one about genetic engineering and wrote a description of the stages of manipulating a bacterium by using plasmids.

Question 6

This question was set in the context of water pollution, the use of indicator organisms and non-biodegradable plastics, all topics that have appeared in question papers in the past. Answers to this question did not always reflect a higher quality of answers in the rest of the paper.

(a) (i) Many candidates identified the rat-tailed maggot, the tubifex worm and the water louse as species that survive in polluted water. Mayfly nymphs were accepted if added to the list. All three (or four) species were required.

(ii) Almost all identified the stonefly nymph as the most sensitive to a decrease in oxygen concentration.

(b) Most candidates stated that sampling points 4 and 5 had a high concentration of nitrate and that this is responsible for the growth of the algae. Simply stating that this region of the stream shows eutrophication was not accepted. Some candidates wrote about 'nitrogen' rather than 'nitrate'. Many only gained partial credit for mentioning that nitrate concentrations were high and then going on to describe that oxygen levels were low without giving any reasons why this would make a difference to growth.

(c) This question was challenging for some. Some candidates did not equate the presence or absence of indicator species as a means to obtain data on the extent of water pollution. They could have referred to Table 6.1 that shows that some invertebrates are more sensitive to changes in oxygen concentration than others. More common was the answer that 'chemicals do not need to be put into the water in the stream'. Candidates did not seem to realise that a chemical analysis is carried out by taking samples of water from the stream and testing them in the field or in the laboratory. Candidates found it hard to articulate their answers, possibly because they had not carried out an investigation similar to the one described in the question using indicator organisms. Some candidates thought that the question was about a study of invertebrates rather than about water pollution and the use of indicator organisms. There were references to the idea that using invertebrates was cheaper or easier to do, however, many chemical and physical tests for pollution are cheap to carry out. They do not need people trained to identify the different types of invertebrates found in freshwater streams and rivers.

(d) The descriptions of sewage treatment were generally very good. It was pleasing to see the use of screens, sedimentation, aerobic digestion and chlorination all itemised in the correct sequence. Few candidates explained that the microorganisms used in sewage treatment digest complex organic compounds into simple compounds and then absorb them. It was good to see activated sludge digesters and trickle filters mentioned in some accounts. Anaerobic digestion was not considered an appropriate stage to include in answering this question. Sewage treatment does not involve the use of antibiotics.

(e) The effect of non-biodegradable plastics on the environment was generally well known. Most candidates restricted their answers to their effects in freshwater habitats. Some candidates stated that these plastics block the light for plants, but did not continue to state that this reduces their rates of photosynthesis. Candidates most commonly discussed the effects of ingesting non-biodegradable plastic and of becoming trapped in it. Mentioned less often were problems of blocking water flow and the detrimental effects of plastics on habitats, ecosystems, food chains or food webs.

BIOLOGY

Paper 0610/33
Extended Theory

Key Messages

- Candidates should always pay close attention to the command words in questions, especially when they follow data in the form of graphs and tables. The distinction between describe and explain was not clearly demonstrated by some candidates. This was noticeable in **Question 3** and **Question 5**.

- There are some biological terms that are easily confused if misspelt. Examples seen included meiosis and mitosis, fission and fusion, glycogen and glucagon. Candidates must use the correct spelling of these words to avoid ambiguity.

- The syllabus includes several definitions of key terms. **Question 3 (c)(i)** and **Question 6 (a)** asked for definitions of anaerobic respiration and genetic engineering respectively. Many candidates gave the syllabus definitions, but many did not. Candidates are advised to revise these definitions thoroughly. Some of these definitions have been revised slightly in the new syllabus.

- Explanations of the effect of exercise on the body often require candidates to state that there is an increase in muscle contraction, an increase in the demand for energy and therefore and increase in the rate of respiration. Often the word ‘more’ used several times is sufficient to convey the right ideas, but sadly it is often omitted and the idea that there is an increase in these aspects of physiology is not conveyed at all.

- If candidates use a bullet point list in their response the point must contain sufficient detail.

- Candidates should be encouraged to use the correct scientific terminology. A number of candidates used terms such as ‘messages’ for impulses and ‘water concentration’ when water potential should be used and the ‘production of energy’ instead of the release or transfer of energy.

- The working for calculations should always be shown as credit is always given if the answer is incorrect but a key step in the calculation is shown correctly.

General Comments

Many very well-prepared candidates scored highly on this question paper. Some candidates found the questions that required application of knowledge, such as **Question 3 (d)** and **Question 4 (d)** more challenging than some complex technical questions, such as **Question 1 (c)(ii)** and **Question 2 (d)(i)**. There was some evidence that genetic engineering, examined in **Question 6**, was a topic that was not well understood by some candidates.

It appeared as if all candidates had time to complete the paper.

Comments on Specific Questions

Question 1

(a) (i) Almost all candidates were able to identify correctly a visible feature of mammals, with fur/hair being the most common response. Common incorrect answers included number of legs and 'ears' without suitable qualification such as *external* ears or use of the term pinna. It was pleasing to note that it was very rare for candidates to suggest features that were not visible in Fig. 1.1.

(ii) Identifying the marsupials in the dichotomous key was completed correctly by most candidates. The most common mistakes were to misidentify A, D and F.

(b) (i) Most candidates knew that the process that forms gametes is called meiosis with only a few stating that it was mitosis. The most common incorrect responses were 'sexual reproduction', 'fertilisation' and 'fusion'.

(ii) The importance of sexual reproduction was slightly less well understood with many answers consisting of a bulleted list of keywords that were often too vague to gain credit. Some candidates did not read the question carefully and attempted to describe the process of sexual reproduction, rather than to explain its importance. The best answers showed an understanding of the expression of recessive alleles and adaptation to changes in the environment. Some responses stated adaptation to the environment, but missed the importance of different environments or of changes in the environment. The statements for which most candidates gained credit were references to avoidance of extinction and the idea that sexual reproduction introduces or maintains variation.

(c) (i) The role of the placenta was described well by many candidates. A lack of clarity in describing the direction of movement of substances between the mother and fetus meant that little credit could be awarded for some answers: for example, 'nutrients and urea pass between the mother and the fetus'. It was reassuring to note that very few candidates made the mistake of referring to the passage of blood or of oxygenated blood across the placenta.

(ii) The most common correct functions of the amniotic fluid that were given were protection from shock, allowing movement of the fetus and the maintenance of body temperature. Some candidates did not gain credit because their answers contained insufficient detail; for example, many used the phrase 'for protection' without stating the type of danger. The most common misconception was that the amniotic fluid provides nutrients to the fetus or removes waste products from the fetus.

Question 2

The liver was the unifying theme in this question. Although this is a complex organ of the human body, it was apparent that many candidates were well prepared to answer the questions confidently. It was evident, however, that in some cases, questions were not read carefully and irrelevant statements were made.

(a) Most candidates identified the hepatic portal vein. A small number of candidates incorrectly named it as the 'hepatic portal artery', but the names of other blood vessels were seen very rarely.

(b) Many candidates stated two correct features of veins. However, a number of candidates were then not able to give creditworthy roles for these features. Many thought that the role of a large lumen or a thin muscular wall was to ensure more blood flow in veins. The link between valves and the prevention of backflow was given frequently.

(c) Most candidates calculated the correct percentage increase in the blood glucose concentration. The most common error in the calculation was to divide the difference by 181 instead of by 135. A small number of candidates failed to provide their answer to the nearest whole number.

(d) (i) There were some excellent explanations of the role of the liver in decreasing blood glucose concentrations. All points from the mark scheme were seen on the scripts. The most common misconceptions were the suggestion that the liver produces insulin and that the hormone was directly responsible for the conversion of glucose to glycogen. A small minority of candidates confused glucagon with insulin or confused glucagon with glycogen.

(ii) Although most candidates knew another factor controlled by homeostasis, it was apparent that some candidates were not familiar with this term. It was unsurprising that the regulation of body temperature was the most common answer, although a wide range of other valid physiological factors were also seen and credited. Some answers stated processes such as 'shivering' and 'vasodilation', but as these were not qualified or linked to temperature regulation credit was not awarded.

(e) Many candidates gave good descriptions of deamination. Many candidates mentioned that amino acids were converted to urea. However, a significant number of candidates also gained credit for identifying the production of carbohydrates in this process. A common misinterpretation of the question led candidates to describe the digestion of proteins.

(f) The breakdown of alcohol, toxins and hormones or the production of bile were the most common roles of the liver that were given in answer to this question. A small minority of candidates did not read this question carefully and stated 'deamination' or 'the storage of glycogen'.

Question 3

Parts **(a), (b)** and **(d)** were often less well answered than the direct factual questions, for example **(c)(i)** and **(c)(iii)**.

(a) Many candidates described why the pulse rate increases during exercise. A small number of candidates did not gain credit for references to oxygen or glucose because they did not state the need for an increased requirement for these components of the blood. A common misconception appeared to be that an increase in ventilation rate or breathing rate is responsible for a rise in heart rate.

(b) Good descriptions of the data describing the increase in lactic acid concentration of untrained cyclists were seen. Some candidates did not read the question carefully as they compared the data for the trained and untrained cyclists. Some also did not give the units when stating relevant data points. A small number of students simply quoted data at each level of exercise rather than describe an overall trend.

(c) (i) Many candidates knew the definition of anaerobic respiration. Two common misconceptions were the mention of *producing* energy, rather than *releasing* energy and the idea that anaerobic respiration requires *less* oxygen rather than none at all.

(ii) Most candidates knew that lactic acid enters the blood by diffusion. Incorrect answers were very rare.

(iii) Almost all candidates knew that the lactic acid is transported in the blood plasma. The most frequently incorrect answers were 'red blood cells' and 'haemoglobin'.

(d) Many candidates found it challenging to explain why the concentration of lactic acid of trained athletes differed from the concentration in the untrained athletes after exercise. Answers related to either trained or untrained cyclists were acceptable, but a large number of candidates attempted to relate fitness to an ability to tolerate lactic acid and only a very few made reference to differences in the oxygen debt. A common misconception was that trained athletes required less energy, or required less oxygen to release the same energy as untrained athletes.

Question 4

(a) Most candidates knew that water moves from the soil into roots by osmosis, but fewer candidates gave sufficient detail to gain full credit. Reference to partially permeable membranes was commonly omitted or misunderstood. Candidates should remember to use the term water potential rather than 'water concentration'.

(b) (i) Many very detailed answers describing the role of the stomata were seen. One common misconception was that water *enters* the leaf through stomata.

(ii) Many candidates noticed that there were more stomata in olive variety **A** compared with variety **B**, but few counted the number of stomata present in each photograph. Others attempted to relate density to stomatal size or opening. It was clear that some candidates did not understand the term 'density' in this context.

(iii) Some candidates found it difficult to apply their knowledge of water uptake to why the rate of water uptake in plant **A** was higher than that in plant **B**. Answers were seen that met all the required points, but in others it was clear that the candidates had not read the question carefully and as a result explained how environmental conditions can influence water loss.

(c) A wide variety of adaptations shown by leaves to dry environments were described. Whilst many candidates identified the waxy cuticle as a suitable adaptation, they did not state that the waxy cuticle is thick or thicker. The most common errors were irrelevant references to adaptations of stems and roots.

(d) This question required candidates to describe the water cycle. This was answered well by the majority of candidates. The only confusion seemed to be that water vapour condenses to form clouds, not that clouds condense to form rain. The term 'precipitation' was rarely used with candidates using 'rain' instead.

Question 5

Many candidates seemed well-versed in environmental issues and answers were well-considered and applicable to the question.

(a) The environmental consequences of non-biodegradable plastics were described well by many candidates. Many answers showed a good understanding and were well written giving sufficient detail. The most common reason for not gaining credit was where the cause of the effect to the environment or organism was not described.

(b) (i) This question required candidates to compare a table of data comparing the manufacture of paper bags and plastic bags. The majority understood the requirements of the question and made use of the available data. Many quoted data, but did not refer to values 'per bag'.

(ii) The effects of waterborne chemical wastes on the environment were less well described. A number of candidates erroneously referred to eutrophication or acid rain; others did not discuss the effects on *aquatic* environments as required by the question.

(c) (i) A minority of candidates did not notice that this question asked to compare the data from both tables for energy requirements for making and recycling plastic bags even though the relevant words were emboldened.

(ii) This question was generally well answered. Deforestation and global warming were the main environmental concerns raised by the manufacture of paper bags. Those candidates who were able to identify these concerns from the table and address them demonstrated a sound knowledge of this topic. Those who did not consider these ideas often gave information about energy consumption that was usually too vague to gain credit.

Question 6

(a) Not all candidates were able to give confident definitions of genetic engineering. A few appeared to confuse genetic engineering with selective breeding.

(b) Candidates were required to complete a table that referred to the stages in producing insulin shown in a flow diagram. Many found this challenging.

(c) Most candidates were able gain some credit for describing the advantages of asexual reproduction to the production of genetically engineered insulin. Reference to the lack of any variation in future generations and the idea of it being faster or more energy efficient were the most frequent correct responses. Some excellent answers were seen where candidates realised that the same type of insulin would be produced and that the modification procedure would only need to be performed once.

BIOLOGY

Paper 0610/04
Coursework

Key Messages

The choice of tasks must be made very carefully, to ensure that the task allows candidates to demonstrate their full abilities within the chosen skill area or areas.

Work should be fully marked (annotated) by the teacher.

Details of each task must be provided for external moderation.

General Comments

Most Centres took care to provide all documentation, fully completed and carefully organised. Experiment Forms, for example, referred to the tasks and combinations of assessed skills. Evidence provided included worksheets and work samples.

External Moderators require complete information about how the assessment of candidates was carried out. This includes full details of the tasks that were set. This could be in the form of copies of the worksheets provided to the candidates, or a summary of oral instructions that were given to them.

It is also important that the samples of candidates' work have been fully and clearly marked by the teacher carrying out the assessment. This involves writing on the work itself by hand, or adding comments in Word if the work has been submitted to the teacher electronically. Original work, annotated by the teacher, is expected rather than copies.

Several Centres provided very fully marked work, with detailed comments that provided excellent feedback to the individual candidates, and also thorough explanations of why a particular mark had been awarded.

For C1, no written work by the candidate will be produced, but the Centre should provide some evidence for the way in which the mark has been obtained. This is generally done in the form of a checklist, completed 'live' as the candidates work through the task.

In general, Centres have become adept at providing tasks that allow candidates access to the full range of marks. Examples that make this difficult include; results charts that contains only three results of food tests, as this does not allow a candidate to reach a mark of 5 or 6 for C2; non-quantitative tasks make it almost impossible to achieve a mark of 6 for C3, and problems that do not involve the effect of one variable on another preclude the award of high marks for C4.

BIOLOGY

Paper 0610/51

Practical Test

Key Messages

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

To maximise marks, candidates

- are advised to pay particular attention to careful reading of the questions to plan the available time before starting to answer.
- construct tables to have column headings that include the units and sufficient rows to show results clearly.
- understand how results are collected and measured, so that sources of error can be recognised and ways of improving an experiment can be suggested.
- drawings need to be made using an HB pencil (not ink) so that use of an eraser can thoroughly remove all double lines.The guide line for a label must make contact with the structure intended without a gap or an arrow head.
- In descriptions of results for food tests to give the starting colour and the final colour to show if a food substance is present or not.
- to select the correct type of graph to construct, to label the graph axes clearly with the variable being plotted, including the units and use scales that occupy at least half of the grid.
- measurements must use SI units as specified in the syllabus.

General Comments

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

There were some excellent examples of tables drawn carefully with a ruler and with units in the table headings. Some responses lacked sufficient columns or rows in tables which made recording observations difficult.

The Supervisor's Report is very important in ensuring that candidates are credited appropriately when materials have to be changed from those specified in the Confidential Instructions. If any difficulties arise there is time to seek advice about alternative materials from Cambridge Assessment, using the contact information in the Confidential Instructions. The Supervisor's Report should include as much detail as possible to allow examiners to assess the candidates' answers appropriately.

Comments on Specific Questions

Question 1

(a) (i) The first question was based on the iodine test to record the observations for the presence of starch in the solution. The test with water was to indicate the absence of starch; it is essential to record the colours observed, not to record that with the water stayed the same.

(ii) The purpose of the second test was for comparison, and referred to as the control test for the investigation to follow. Many answers correctly stated this purpose.

(b) (i) and **(ii)** After reading the instructions a suitable results table was successfully presented by most candidates recording observations made over a period of eight minutes for both test-tubes with the buffered amylase mixtures at pH5 and pH7. The column or row headings should contain the time in minutes and the two pH values for tests. The times and observations were individually recorded by most. A few tables did not include lines to separate the observations.

(c) Both mixtures should have changed showing the breakdown of starch by the enzyme amylase and one pH should complete the breakdown faster. The Supervisor's reports were consulted for each Centre to give a comparative indication. When data is described it is always useful to illustrate with simple calculated figures e.g. subtract the time difference between pH5 and pH7 breakdown of starch in the mixtures.

(d) Many improvements were possible and better responses listed a least two correct ideas. Measuring the volumes of iodine solution; spacing the drops on other tiles; repeating to improve reliability; and controlling temperature were the most frequent noticed. If the iodine solution is added to the mixtures of starch solution and amylase, the activity of the enzyme would be affected.

Question 2

(a) (i) Interpretation of details for the drawing of a group of five grains of a maize cob, varied from the view as shown in the Fig.2.2. It was clear that this illustration had not been observed by candidates. It was not appropriate to draw five separated grains. Most drawings were reasonably sized, larger than recorded by the Supervisor for the specimens. An ideal size should occupy more than half of the space provided, and the outlines for each of the grains, made using a single, unbroken line with an HB pencil (not ink).

(ii) Most candidates measured the length on one grain in millimetres.

(iii) The size of the single grain was checked with that recorded by the candidate, so the scaled outline was constructed to have the required magnification. The label was frequently omitted.

(b) (i) Most grain counts were made to include the partial grains, shown in Fig. 2.2, to complete the table.

(ii) It is important grain counts were made to give data to suggest an appropriate phenotype ratio; that should show whole numbers and to represent a simplification of the count for the dark and light grains.

(iii) A range of possible alternative visual features were described, e.g. shape, size, appearance other than colour.

(c) Descriptions for the procedure to carry out food tests for protein and fat were recorded correctly by many candidates, to include both the colour of the reagent(s) before addition of suitably prepared extract of the grains, and the expected colour change to indicate the presence of these food types.

(d) (i) Many candidates plotted excellent bar charts. There are six different cereals and both the protein and fat content to be considered; it is important that a bar chart is used as all the data can be scaled so that these fit on the same axes. In this form of a bar chart, the grain types appear along the horizontal (x) axis; the height of the bar (y) corresponds to the value of each protein and fat content. The comparisons can be shown with paired bars or stacked bars to be equal in width and equally spaced to separate each cereal type. This is a complex bar chart so most candidates used a key to distinguish the fat or protein content. It is not appropriate to plot protein content against fat content.

(ii) The calculations were correctly made. It is important to simplify the two values for protein in wheat and rice.

(iii) Oats were correctly named as the cereal that contained the largest energy content, and included an explanation based on the greatest fat as well as the high but not highest protein content. Those candidates that selected wheat only considered the highest protein content.

BIOLOGY

Paper 0610/52

Practical Test

Key Points

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

To maximise marks, candidates

- are advised to pay particular attention to careful reading of the questions to plan the available time before starting to answer.
- construct tables to have column headings that include the units and sufficient rows to show results clearly.
- label graph axes clearly with the variable being plotted, including the units and use scales that occupy at least half of the grid.
- understand how results are collected and measured, so that sources of error can be recognised and ways of improving an experiment can be suggested.
- drawings need to be made using an HB pencil (not ink) so that use of an eraser can thoroughly remove all double lines. The guide line for a label must make contact with the structure intended without a gap or an arrow head.
- measurements must use SI units as specified in the syllabus.

General Comments

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

There were some excellent examples of tables drawn carefully with a ruler and with units in the table headings. Some responses lacked sufficient columns or rows in tables which made recording observations difficult. Units were often in the body of the table and given in minutes and seconds when candidates were required to record time in seconds.

The Supervisor's Report is very important in ensuring that candidates are credited appropriately when materials have to be changed from those specified in the confidential instructions. If any difficulties arise there is time to seek advice about alternative materials from Cambridge Assessment, using the contact information in the Confidential Instructions. The Supervisor's Report should include as much detail as possible to allow examiners to assess the candidates' answers appropriately.

Comments on Specific Questions

Question 1

(a) Most candidates constructed neat ruled tables and included sufficient cells to display all the times recorded, in seconds, for the methylene blue to return to its original colour in the yeast suspension for each test-tube, as well as the temperature, in °C, in each beaker.

Although most candidates did include the correct units in their headings, the most common error was to repeat the units in each of the cells after their results. Units should only appear in the column headings.

The Supervisor's Reports were an important source of information as there was variation in the temperatures recorded within centres according to laboratory conditions and these were taken into

consideration when observing the times recorded by candidates. The recorded times varied widely, affected by the source and activity of the yeast suspensions that were used.

(b) (i) Many candidates suggested that repeating the investigation would increase reliability of the results. The extra tests would not eliminate errors or anomalies, or increase accuracy but would show if errors had been made if results differed.

(ii) A positive correlation conclusion was made by most candidates between the higher temperature and a shorter time for the colour change depending on the increased activity of the yeast in suspension.

(c) (i) Candidates were asked to suggest why the method of timing was a source of error. Some candidates failed to realise that, either there would be difficulty watching three colour changes and timing each to give final change, or that it could be difficult to judge the exact time when it goes from blue to colourless. An alternative suggestion might have been based on the fluctuations in temperature affecting the activity of the yeast in the suspensions.

(ii) Good responses suggested timing each test-tubes separately or involving a means to compare the colour change clearly, e.g. placing a white card behind the tube.

(iii) The suggestions seen involved the activity of the yeast provided, the size of the test-tubes, stirring the tube contents, measuring the volume of gas given off, or the changes by cooling (of the 'hot' beaker) or warming (of the 'cold' beaker) of the temperatures of the water in the beakers.

(d) (i) Most candidates correctly calculated the rate of carbon dioxide production for pH7. Not all of the candidates showed their working as requested.

(ii) Many candidates gained maximum credit for this part of the question. Using data from Table 1.1 candidates were asked to draw a graph to show the effect of pH on the rate of carbon dioxide production. Better answers correctly orientated the axes and used the headings from the table as their axes labels. The two requested variables, the independent variable, pH, should be plotted on the horizontal axis (*x*), and the dependent variable, rate of carbon dioxide cm^3 per minute, on the vertical axis (*y*).

The first column in this table contained data for the average volume of carbon dioxide produced in 30 minutes / cm^3 and a small number of candidates incorrectly plotted a graph for this against pH. A few graphs were seen where the candidates had incorrectly plotted average volume of carbon dioxide against rate of carbon dioxide produced cm^3 per minute. This illustrates the importance of reading the question carefully.

Candidates were expected to use the whole grid to plot the data and not extend beyond the grid; the values must be evenly spaced along each axis. Those that did use a suitable and even scale did not need to increase the size of the grid. The pH scale only needed to cover from pH4 to pH8. Most candidates plotted the points accurately unless an inappropriate or small scale was used or the plot points were so large that they occupied a 1mm grid square. Candidates should be encouraged to use small crosses or dots inside circles to place plot points. These should be less than 0.5 mm^2.

The plot points should be joined by ruled lines or a smooth curve to form a line graph and this line should not be extrapolated beyond the data plot points.

There are two continuous variables to be considered so it is not appropriate to use a column graph such as a histogram or bar chart to plot the data as requested from Table 1.1.

(iii) Most candidates gave a correct trend; better answers also noted that the relationship was proportional or showed a positive correlation and linked a suitable pH to changes in the activity of enzymes. Many candidates quoted raw data, which was not credited. Some processing of the data was expected, e.g. the rate of carbon dioxide produced doubles between pH4 and pH5.

Question 2

(a) (i) Although the outline and size of drawings were suitable, it was the detail of the main areas within the grain that were omitted.

Drawings need to be made using an HB pencil (not ink) so that the use of an eraser can thoroughly remove all double lines to leave a single continuous unbroken line.

(ii) Most candidates measured, both the line **XY** on Fig.2.1 and drew a similar line on their drawing, correctly measured it accurately in millimetres. Very few candidates failed to follow instructions to draw a line **XY** on their drawing. The two measurements were used correctly in the formula (drawing size ÷ image size in Fig. 2.1), to calculate magnification of their individual drawing. This magnification needs to be recorded without a unit and it is not a percentage calculation.

(b) (i) Differences in the shape and appearance of the outer layer were the most common features selected. Comparing the size was not valid as the diagrams in Fig.2.1 clearly stated 'not to scale'.

(ii) This was well answered.

(c) (i) The question referred to 'using a microscope' but this was not considered by candidates. Pollen grains are minute and cannot be measured with an ordinary ruler. So although not familiar with the idea of measuring using a microscope, it was possible to suggest using a scale that would be suitable for use in a microscope. A few responses did refer to an eyepiece scale or graticule.

(ii) To make a comparison there were clearly two different phases of growth of the pollen tubes up to and after the first 6–8 minutes. If a calculation was made of the overall sets of data, e.g. pollen grain **S** was 11.3 µm longer than pollen tube **R** after 20 minutes; credit was given but not for merely quoting directly values for the length of the pollen tubes.

(d) (i) This technique of sampling was not commonly known. There was confusion over the terms seeds and fruits; similarly the need to count the seeds in each fruit individually not to first mix all the seeds together. This is an area of sampling that has not been covered by all.

(ii) This was well answered. The most common error was 36 which was the value of the highest frequency rather than number of seeds in a fruit.

(iii) This was well answered giving the number of seeds in a fruit that has a frequency of 12.

(iv) There are many reasons why some fruits have a lower number of seeds than others. A range of possible ones were considered. Confusion over use of terms ovule, seed and fruit was noted.

BIOLOGY

Paper 0610/53

Practical Test

Key Messages

It is essential that candidates experience as much practical work as possible during their programme of study in order to practice the skills required.

To achieve high marks candidates should:

- read questions carefully before starting to answer and give only the number of responses required for questions that ask for a specific number.
- be able to identify the different types of variables in a practical.
- know how to draw tables that display data clearly using suitable column and row headings, and appropriate units.
- be able to select suitable features for comparison between biological specimens.

General Comments

There were many examples of clear well-presented answers, showing thorough preparation and careful thought. There were some excellent examples of tables drawn carefully with a ruler and with units in the table headings. Errors seen in tables included those drawn with irregular lines without column headings and with units often in the body of the table. There were also some excellent examples of graphs with scales that fitted all of the grid space provided and could be plotted accurately. Poorer graphs had irregular scales and the bars plotted adjacent to each other instead of with a space between them. Graphs should be plotted so that most of the grid area is used so the choice of a suitable scale is essential.

Drawings were mostly of a good standard showing clear outlines in pencil and occupying most of the space provided.

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

Comments on Specific Questions

Question 1

The practical skills tested were accurate measurement using SI units, preparation of a table, recording and describing results, explaining controlled variables and using given data.

(a) (i) Almost all candidates gave a correct answer to this question.

(ii) The only common error was to give only the final colour of biuret reagent and not include the starting colour as the question clearly asked for the colour change. As the test solution was milk, a change from white to purple / lilac was allowed.

(iii) The majority of candidates gave a correct answer, usually to wear gloves.

(b) Most candidates were able to convert minutes to seconds. Some candidates converted readings in seconds to proportions of a minute. This is not necessary and likely to lead to errors in calculations.

(c) Most candidates were able to construct the table. Good responses showed a first column with the heading 'solution or test-tube' and a second column with the heading 'time / s'.

SI units should be used and appropriate units of time recorded avoiding the use of minutes or minutes and seconds in the table heading. It should be noted that is the 'm' is the abbreviation of metres not minutes. As in part (b) some candidates converted seconds to proportions of a minute, which was not acceptable. The expected SI unit for time is seconds (s), so candidates should be encouraged to measure in whole seconds reactions that take less time than five minutes. Some tables omitted the results for 'no X' or incorrectly named this as 'X'.

The Supervisor's results for this experiment showed a wide variation in actual time for clotting, particularly when two or three sets of results were provided. These results were important to ensure the solutions were behaving as expected. A wide range of times were accepted as candidates found it difficult to observe the expected point of clotting. It was apparent that some candidates might have mislabelled or mixed up their tubes as their results did not follow the expected trend.

(d) Very few candidates were able to give a good description of the trend shown by their results. Candidates were expected to observe that the presence of X decreased the time taken for clotting, that X1 caused a greater decrease than X2, and to process some data from their results to support their answer. Only the best answers used any processed data. Better answers were able to identify the trend and recognise the effect of solution X. Incomplete answers tended to describe the individual results in the table without identifying any trend. Those candidates, who obtained results that did not follow the expected trend, but were able to describe the pattern shown buy their results, were able to gain credit. It was evident from some of the better answers that there is some confusion between describing results and explaining results. Consequently many of the candidates went on to state that X1 was a more concentrated solution than X2, or that X must be another enzyme that helps clotting or that X gave the optimum pH for rennin.

(e) This was answered well by most candidates who stated that milk volume was a controlled variable. The best answers showed the expected understanding that a change in volume would change the substrate available and hence the time taken for clotting.

(f) The best answers showed that the candidate had realised that the temperature of the water would decrease during the time that the second set of tests using solution X were set up, so that the enzyme activity would be reduced and make the results less valid. Some of the better answers also noted that two variables would be changed making the results invalid. Many candidates assumed that 40 °C was the optimum for rennin, but there is no evidence in the question to support this and it does not answer the question as to why the water was replaced.

(g) (i) Almost all candidates gave a correct answer.

(ii) A few candidates incorrectly identified amylase, suggesting some confusion about which part of the pH scale is acid.

Question 2

This question tested the practical skills of observing and drawing from biological specimens, calculating a percentage change, plotting a graph and interpreting experimental data.

(a) Most candidates were able to draw an outline of the leaf that resembled the specimen provided. Better drawings were drawn with a sharp pencil without any gaps or shading and with clearly drawn veins showing their thickness and position on the leaf. Some poorer drawings were drawn using very heavy thick lines with the veins shown as short sketchy lines. While the majority of candidates used most of the space provided, some extended into the printed part of the page which should be discouraged. The best drawings reflected the actual appearance of the specimen provided, so that the thickness of the mid-rib, the pattern of the main veins and the relative proportions of the leaf and petiole were accurate. Errors seen included showing the mid-rib as a single line and the origin of the main veins from the mid-rib was not carefully observed, for example drawn as pairs, rather than alternating. The Supervisor's Reports, particularly the photographs, were essential for this part of the paper to inform examiners of the appearance of the leaves.

(b) (i) Most candidates gave a correct answer. A few candidates divided by the final mass rather than the starting mass.

(ii) The best answers showed the understanding that valid comparisons cannot be made if the starting masses are different. The majority of answers however gave one or other of these idea, commonly that the starting masses were different.

(iii) There were a great many well-presented graphs that gained maximum credit. Candidates should be encouraged to follow good practice by plotting the independent variable along the *x*-axis and the dependent variable on the *y*-axis. Some candidates clearly understood how to plot graphs but omitted to add units to their axes labels. The most common error was to omit a gap between the bars of the graph. There were relatively few examples of careless plotting. Error carried forward was allowed for plots made from an incorrect calculation in part **(b)(i).** It is not necessary to shade bars and where candidates do they should take care not to extend the shading outside the edges of the bar.

(iv) Many candidates gave a correct answer. The most common error was to confuse the side covered by petroleum jelly with the side exposed and conclude that upper surface lost the most water because leaf **Q** lost the most water.

(c) Most candidates identified temperature as the independent variable. The most common errors were starting mass of leaf and time.

Most candidates chose at least one correct variable that should be controlled, commonly wind speed and light. Some responses show a lack of understanding of the differences between the controlled, independent and dependent variables.

Answers identifying the dependent variable indicated some uncertainty about the variable being measured and the calculated values derived from this. The actual dependent variable is the mass of the leaf; the percentage change and rate of water loss or rate of transpiration are calculated values.

Question 3

This question tested practical skills of observation, measuring and calculating magnification.

(a) Most candidates were able to identify one feature of the blood cells. The best answers tended to select the nucleus, cell shape or cell size, although a surprising number of candidates did not choose two of these obvious features. Some of the better answer referred to the number or density of cells visible. Credit was allowed for a colour comparison, but these were usually too vague for credit, for example pale and dark cells. A great many candidates stated that human red blood cells were biconcave discs, which is not visible in the photograph. When making comparisons, candidates should always refer to visible features. If the names of features are not known, credit can still be gained by descriptions, for example instead of nucleus, candidates could have stated 'centre of the cell' as a feature and described human cells as having a pale centre and frog cells as having a dark centre. The 'space between cells' is not a feature of a cell.

(b) Almost all candidates measured the length of the scale bar correctly and the majority knew how to calculate magnification from their measurement. Error carried forward was allowed for the candidates' measurements that were incorrect. Errors arose where candidates failed to convert centimetres to millimetres, thus arriving at an incorrect magnification. Another common error was to multiply by 100. A few candidates failed to round their answer to the nearest whole number.

(c) A wide range of answers was accepted. The most common incorrect answers were meiosis and control the movement of substances into the cell.

BIOLOGY

Paper 0610/61

Alternative to Practical

Key Points

Candidates should have experience of practical procedures as outlined in the syllabus so that they are familiar with experimental methods and are suitably prepared for this paper.

General comments

Overall, questions were answered well and candidates were well prepared for the exam. The marks seen covered the whole range of abilities. To do well, candidates must read questions really carefully to make sure they are giving enough detail in their answers. They must also take time to interpret the data and information given and use the data to answer the question if required. Care must be taken when looking at the key words in the question. For example, questions starting with 'describe' need to be answered differently to those starting with 'explain'.

It is important that candidates use a good HB pencil and eraser for drawings. Drawings should be drawn with clear, continuous lines and have no shading.

When drawing a graph, candidates should label the axes, with units, and use an even scale for each axis. The independent variable should be plotted on the x-axis and dependent variable on the y-axis. The plots should be drawn with a sharp HB pencil with the point no larger than half a small square in size. The plots should be joined with a clear, unbroken line, point to point.

Comments on Specific Questions

Question 1

This question involved knowledge and understanding of practical procedures (starch test and investigating the effect of pH on the activity of amylase during the breakdown of starch), handling data and drawing conclusions. The results were given for the investigation and candidates had to draw a graph using the results table given, and comment on the results and experiment.

(a) Candidates had to describe a test to safely show the presence of starch in a solution. The majority of candidates were able to correctly state that the reagent used to test for starch is iodine solution rather than just iodine. Candidates should remember to state the starting colour of the iodine solution and the colour that it turns in the presence of starch. Some did not describe how to do the test safely, e.g. using goggles or wearing a lab coat.

(b) (i) Most line graphs were well drawn with the independent variable (pH) on the x-axis and the dependent variable (time) on the y-axis. The majority of candidates labelled the axes including units for time (minutes) and evenly scaled the axes. Most candidates made full use of the space available and used 10 small squares for each minute and 5 small squares for each pH value. Candidates are reminded that they should use very small dots or crosses to plot the data, no more than half a small square in size. The data points should be joined by a clear, unbroken line starting at the first point and going through all points before finishing at the final point. The line should not be extrapolated beyond the points and should not go through zero. The selection of a bar chart was incorrect for the data given.

(ii) Candidates had to use their graph to answer this question. Most correctly identified that the optimum pH was 4.

(iii) Candidates were given a formula and had to calculate the rate of activity of the enzyme at the pH they gave in the previous question. Most candidates were able to correctly apply the formula and remember to round their answer to a whole number.

(iv) Good responses used the data to make a calculation, e.g. between pH3 and pH4 the time taken is 3.6 minutes less or by referring to a difference in the gradient before and after the optimum pH.

(c) (i) Many candidates were able to name two controlled variables. Temperature and volume of starch/amylase being the most common answers. A few candidates gave examples that were the independent or dependent variables.

(ii) Many were able to explain that repeating the investigation and calculating an average of the results would improve the reliability of the investigation. Of the alternatives offered many would not have improved the investigation, e.g. using pH values beyond 3-8. Testing at smaller intervals between pH3-8, would be an improvement as you would be able to more precisely find the optimum pH. some candidates correctly explained how a water-bath could be used to control the temperature.

Question 2

(a) (i) The majority of candidates were able to answer this question correctly.

(ii) Many candidates gave correct responses. Often the answer from **2ai** was given as a ratio and candidates did not realise that this is approximately a ratio of 1:1.

(iii) This was well answered with the most common answers related to differences in the size and shape of the grains.

(b) The majority of candidates recalled that Biuret solution is used to test for protein and that the emulsion test is used to test for fats. However, some candidates forgot that the maize grain should be prepared in some way before the test is done, e.g. by crushing it. Also, as with the iodine test in **Question 1a**, many candidates only said that Biuret solution turns purple if there are proteins, but did not say that it starts off blue. Most candidates accurately recalled the emulsion test for fats, although some forgot that water is also added, as well as ethanol.

(c) Candidates had to use the data table to identify which cereal provides the largest energy content. Most correctly identified this as oats but fewer were able to explain why. Some stated the number of grams of fats and proteins in 100 g of oats, but did not interpret this data in any way.

Question 3

(a) (i) Veins was the most common answer given, followed by midrib. Some candidates were able to identify structure such as the petiole or lamina. Common errors included stem, references to colour and references to shape.

(ii) Most candidates correctly said that leaf P is divided into leaflets (and leaf Q is not). A second difference was more difficult to identify. There were many references to the shape of the leaves, but not specifically to the edge or tip of the leaf. A wide range of suggestions was seen.

(b) (i) A small number of candidates only drew the tendrils and not the rest of the plant. The outline had to be drawn with single, clear, unbroken lines with no shading anywhere. The standard of outline was generally very good. Only a small number of candidates represented the climbing plant incorrectly with shading and overlapping lines.

Most drawings were of an acceptable size and larger than the picture. An ideal size would be to use most of the space provided, but not to overlap into the print.

Details required in the drawing were a clear midrib and four veins radiating from the same point with some branching veins. Most candidates correctly depicted the tendrils, each showing a forked structure.

(ii) Most realised that the advantage of tendrils is that they allow the plant to climb or support the plant. One misconception was that leaves grow out of the tendrils.

Suggesting a disadvantage proved to be more challenging. Good responses included the referece to less leaves resulting in less photosynthesis.

(c) Some candidates realised that there was a difference in the vein pattern, but many still found it difficult to describe the difference. Not parallel vs. parallel was not accepted as an answer. The veins for the eudicotyledonous leaf needed to be described as a network or branching, not as going from the centre outwards. Some correctly identified the leaf shape as another difference, but again found it difficult to correctly describe the different leaf shapes. The eudicotyledonous leaves should to be described as broad or wide, rather than round, which was commonly given.

BIOLOGY

Paper 0610/62
Alternative to Practical

Key Points

Candidates should have experience of practical procedures as outlined in the syllabus so that they are familiar with experimental methods and are suitably prepared for this paper.

To do well, candidates need to read questions carefully before starting to answer. They must read through all the information given in an introduction or method so that they can use this in their answers, if required. Candidates must always be prepared to go back and look at these details more than once.

General comments

Overall, candidates were well prepared to answer the questions and most candidates completed the paper.

When constructing a table candidates should use ruled lines to make enough columns and rows to display all the results to be included. Multiple results in one cell are not acceptable. Headings with the correct units should accurately reflect the results to be displayed in the table. Units should only be found in the headings and should not be in the individual cells in a table.

When candidates are given numerical data in a table and are asked to use it to compare results or describe a trend then there is no credit in simply quoting figures from the table. Most answers, however, would be enhanced by some manipulation of the data to illustrate points. A simple calculation to show a difference between two values would help illustrate a description in words.

When candidates are required to give a numerical answer, they should look to see how the question requires the answer to be given. In this paper many candidates failed to give an answer to the nearest whole number when asked. They should also know which SI units are required and use their correct abbreviations.

It is important that candidates use a good HB pencil and eraser for drawings. Drawings should be drawn with clear, continuous lines and have no shading.

Candidates must ensure their measurements are accurate and that the correct SI units are used in their answer.

Comments on Specific Questions

Question 1

(a) (i) Many candidates prepared a suitable table to record the results of the investigation.

The majority drew ruled tables and included enough cells to display all the given results of temperature, trials and times. A small number gave results for the three trials or the three temperatures in one cell; each result needs a separate cell.

Most candidates used a suitable heading for ‘temperature’ but a common error was to put headings identifying the different trials, omitting ‘time’.

Although most candidates did include the correct units in their headings, temperature / ^{o}C and time / s, the most common error was to also include the units in the cells with the actual results. This is incorrect, units should only appear once in the headings.

Many candidates incorrectly read the thermometers. The markings went up by 2 °C each time and they incorrectly assumed each mark was 1 °C.

Candidates were asked to record the times shown on the stopwatches in seconds. Some candidates of did not convert the results for the cold beaker and gave the answers in minutes and seconds. The first two digits on the stopwatch are the minutes and these are separated from the other two digits, representing the seconds, by a colon. This is not a decimal point. 02:10 represents 2 minutes and 10 seconds, not 2.10 minutes. In some cases times were incorrectly displayed as decimals.

(b) (i) Many candidates did realise that taking three readings for each temperature would make their results more reliable. However, taking three readings would not ensure any more accuracy, mistakes could still be made. It would not eliminate errors or anomalies. It could, however, make the results more reliable by enabling candidates to identify errors and so avoid using these in their final results. A number of candidates correctly explained that they would be able to take an average result.

(ii) The better candidates did know how to correctly calculate the average times correctly. For these candidates the most common error was that they did not convert their answer to the nearest whole number as required. Some candidates found this challenging.

(iii) This was quite well answered, many candidates made the correct conclusion.

(c) (i) Candidates were asked to suggest why the method of timing was a source of error. This was not well understood. Candidates failed to realise that, either there would be difficulty watching three colour changes at once and timing each final change accurately, or that it could be difficult to judge the exact time when it goes from blue to colourless. The most common errors were that the temperatures might vary, poor timing apparatus, problems related to placing the bung in the test tube or human errors when timing.

(ii) Good responses suggested timing each one separately or using a means to see the colour change clearly e.g. placing a white card behind the tube.

(d) (i) Most candidates correctly calculated the rate of carbon dioxide production for pH7.

(ii) A small number of candidates incorrectly plotted a graph for this data against pH. A few graphs were seen where the candidates had incorrectly plotted these two sets of data against each other without reference to pH.

A line graph was the most suitable graph for the data as both variables are continuous with interval data. A very small number of candidates drew bar charts or histograms.

Overall the graphs were well constructed.

As there are two variables, the independent variable (pH) should be plotted on the horizontal axis (x), the first column in **Table 1.2**, and the dependent variable (rate of carbon dioxide cm^3 per minute) plotted on the vertical axis (y). The axes need to be labelled fully. They should show the full title of each axis as given in the column headings in the table of data and they should include the units.

Candidates were expected to use the whole grid to plot the data and not extend beyond the grid; the values must be evenly spaced along each axis. Those that did use a suitable and even scale did not need to increase the size of the grid. The pH scale only needed to cover from pH4 to pH8. Most candidates plotted the points accurately unless an inappropriate or small scale was used or the plot points were so large that they occupied a 1mm grid square. Candidates should be encouraged to use small crosses or dots inside circles to place plot points. These should be less than 0.5 mm^2.

The plot points should be joined by ruled lines or a smooth curve to form a line graph and this line should not be extrapolated beyond the data plot points.

There are two continuous variables to be considered so it is not appropriate to use a column graph such as a histogram or bar chart to plot the data as requested from Table 1.1.

(iii) Most candidates were able to describe that, as the pH increases, so too does the average volume of carbon dioxide produced and / or the rate of carbon dioxide production. When data is given it is always useful to illustrate a description or trend with simple calculated figures e.g. the rate doubles between pH4 and pH5. There is, however, no added value in quoting examples of figures directly from the table.

The explanation of the trend was difficult for many candidates and only some candidates successfully attempted to link the changes in rate of respiration at different pH values to the changes in the activity of enzymes as pH varies.

Question 2

(a) (i) Although the outline and size of drawings were suitable, it was the detail of the main areas within the grain that were omitted.

Drawings need to be made using an HB pencil (not ink) so that the use of an eraser can thoroughly remove all double lines to leave a single continuous unbroken line.

(ii) Most candidates measured, both the line **XY** on Fig.2.1 and drew a similar line on their drawing, correctly measured it accurately in millimetres. Very few candidates failed to follow instructions to draw a line **XY** on their drawing. The two measurements were used correctly in the formula (drawing size ÷ image size in Fig. 2.1), to calculate magnification of their individual drawing. It is important to note that a magnification is represented by 'x' and the value, it should not include units.

(b) (i) Differences in the shape and appearance of the outer layer were the most common features selected. Comparing the size was not valid as the diagrams in Fig.2.1 clearly stated 'not to scale'.

(ii) This was well answered.

(c) (i) Only a small number of candidates were familiar with a suitable method to measure objects on a microscope slide. The idea of an eyepiece graticule was not well known. The most common errors were to use magnification calculations, magnify the grain and then measure it or use a ruler on the microscope

(ii) To make a comparison there were clearly two different phases of growth of the pollen tubes up to and after the first 6–8 minutes. If a calculation was made of the overall sets of data, e.g. pollen grain **S** was 11.3 µm longer than pollen tube **R** after 20 minutes; credit was given but not for merely quoting directly values for the length of the pollen tubes.

(d) (i) This technique of sampling was not commonly known. There was confusion over the terms seeds and fruits; similarly the need to count the seeds in each fruit individually not to first mix all the seeds together. This is an area of sampling that has not been covered by all.

(ii) This was well answered. The most common error was 36 which was the value of the highest frequency rather than number of seeds in a fruit.

(iii) Candidates were asked to suggest why some fruits have a lower number of seeds than others. A small number of candidates correctly recognised that there may be less ovules, pollination or fertilisation. References to environmental conditions often lacked detail and did not give a specific example linked to lower numbers of seeds e.g. not enough water. The most common errors were to state that it was because some fruits are smaller or it was a genetic factor.

BIOLOGY

Paper 0610/63

Practical Test

Key Messages

Candidates should read questions carefully before starting to write their answer. They should know which SI units to use and the correct abbreviations for them. It is advisable that all stages in a calculation are shown, as partial credit can be given if a mistake is made part way through. Also it is important to do as asked if an answer is required to one decimal place, or to the nearest whole number. The difference between "reliability" and "accuracy" needs to be stressed as does that between "describe" and "explain".

General Comments

The quality of the work showed that candidates were well prepared for this paper; there were many excellent scripts where the answers were accurate, informed, well-reasoned and beautifully presented.

Comments on Specific Questions

Question 1

(a) (i) Very few candidates did not know that the chemical test for proteins involved the use of biuret reagent. Many also knew the chemicals used in Biuret reagent, although this knowledge was not required in the answer. Other tests for the presence of protein were accepted.

Candidates frequently did not achieve the second marking point as they gave no information about preparing the sample. A reference to chopping / grinding the egg white to make a solution was required.

(ii) Most candidates answer this question well with only some candidates giving incomplete answers. The answer should have included the starting and the end colours to show whether the test was positive or negative for the substance being tested. There has been an overall improvement in recent years when candidates answer this type of question as starting colours for reagents are more frequently cited.

(iii) Nearly all candidates gave a second safety procedure to be used during the performance of the food test, the most popular being the wearing of gloves or a laboratory coat.

(b) (i) Candidates were asked to perform two calculations and the great majority answered correctly.

(ii) Many candidates performed the task well. Most tables had sufficient columns and rows and were drawn using a ruler. The relevant information was usually entered. Column headings were the main area where improvements can be made. The appropriate units must be included in the heading and then must not be repeated in subsequent entries in each row.

(c) Good responses made the link between the greater enzyme concentration and the rate of reaction. Some candidates correctly referred to test-tube A not showing a result as no enzyme was present.

(d) This was answered competently and most candidates referred to a control, or for comparative use or to check that the enzyme was needed for the reaction to occur.

(e) Answering this question proved more challenging. Many gained a mark for the idea that enzyme activity varies with temperature. Some attempted to express the idea that if the temperature changed, the results would be less reliable. Some candidates incorrectly used the term "accurate"

or “for a fair test” instead of “reliable”. Very few stated that as temperature was the controlled variable in this investigation, it should be kept constant.

(f) Good responses needed to link small sized pieces with a larger surface area and a higher rate of enzyme action (or vice versa). Many candidates, who identified that the surface area of the pieces would differ, did not then complete the explanation.

(g) (i) This was answered correctly by most candidates.

(ii) Most candidates answered this correctly, a few incorrectly identified amylase as the enzyme that might be found in the stomach. It is possible these candidates did not know which part of the pH scale was “acid”.

Question 2

(a) Most candidates drew good diagrams showing the outline of the leaf, petiole, midrib and main veins using clear unbroken lines. Only a minority were penalised because of sketching, shading or the use of very thick pencils. It needs to be noted that the use of ruled lines (in this case for the midrib) is not acceptable in biological drawings.

The majority of candidates produced diagrams that were larger than the size of the photograph of the leaf.

Fewer candidates gained the mark which was awarded for accurate representation of leaf detail. Leaf shape, alternate main veins, pathway of main veins and the notched petiole were all observable feature of this leaf (although not all of these were necessary to gain the mark).

(b) (i) Most candidates carried out the calculation correctly.

(ii) Most candidates gained one mark here, usually for stating that the results for the leaves could be compared when given as a percentage. Fewer candidates gained the mark for stating that the starting masses of the leaves were different. It appeared that if candidates had given one reason, only some attempted to give a second one. The mark allowance should have indicated that two reasons were required.

(iii) In general, the standard of the bar charts drawn was high, with many candidates gaining full marks. The most frequent reason why candidates lost marks was for drawing a histogram (which has bars that touch each other), rather than a bar chart (where the bars are separated by equal sized gaps). The distinction between a histogram and a bar chart is important and one that needs reinforcing to candidates.

There are some other areas where candidates could improve their performance: axes need to be fully labelled and with units stated, the scale on the axis must has to be even, the bar chart should occupy at least half the grid provided and the bars should be drawn with a ruler. Candidates should be encouraged to draw their axes at the edges of the grid provided.

(iv) Many candidates stated “lower surface” without providing evidence from the results to support their statement. Some candidates gave a well-reasoned explanation.

(c) There is widespread confusion amongst candidates between “independent variable”, “control variables” and the “dependent variable”. Their meanings need to be reinforces to candidates. It was evident that while some candidates did know these terms many did not.

Question 3

(a) The majority of candidates gave sound answers. The majority selected the differences in cell size, cell shape or possession of a nucleus. Difference in the total number of cells present was accepted. Functional differences (which cannot be seen from the photomicrographs) were ignored.

(b) Almost all candidates measured the length of the scale bar correctly and the majority knew how to calculate magnification from their measurement. Error carried forward was allowed for the candidates' measurements that were incorrect. Errors arose where candidates failed to convert centimetres to millimetres, thus arriving at an incorrect magnification. Another common error was to multiply by 100. A few candidates failed to round their answer to the nearest whole number.

(c) The presence of a nucleus in frog red blood cells means that they can undergo mitosis. Able candidates deduced this. Other acceptable answers included function of the nucleus or of the DNA contained within it. Unacceptable answers related to what they knew about differences between mammals and amphibians in general.