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BIOLOGY

Paper 0610/11
Multiple Choice

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

General comments

No question fell outside the scope of the candidates sitting this paper. The genetics questions were more of a problem to candidates this year than they have been in previous years.

Comments on Specific Questions

Question 3

Over a quarter of candidates thought that the key diagnostic feature for the identification of an insect is the possession of wings rather than the possession of three pairs of legs.

Question 6

A quarter of candidates thought that a palisade cell and a guard cell are both part of the same tissue, possibly indicating a misunderstanding of either the definition of a tissue or of what constitutes an organ.

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Question 13

The effect of pH on enzyme action was not well known. The majority of candidates thought incorrectly that the optimum pH for amylase activity is 13.

Question 20

Many candidates did not appreciate that diffusion is a passive process and many did not appreciate that cell division, muscle contraction and protein synthesis all rely on energy released by respiration.

Question 21

More able candidates realised that respiration is an enzyme-controlled reaction whilst many candidates chose one of the options relating to oxygen.

Question 25

Many candidates thought that consumption of alcohol does not cause a loss of muscle coordination.

Question 30

Less able candidates chose one of the options with sunlight, not appreciating that seeds usually germinate in the soil where there is no light.

Question 32

This proved to be the most challenging question on the paper. Almost half of candidates did not realise that a dominant characteristic will be shown in a heterozygous individual.

Question 35

This proved to be the easiest question on the paper, demonstrating the sound grasp that candidates have of food chains.

Question 39

The majority of candidates knew that carbon dioxide contributes to global warming but many candidates chose sulfur dioxide as the other gas rather than methane.

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BIOLOGY

Paper 0610/12
Multiple Choice

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

General comments

This paper was handled competently by the majority of candidates. Candidates found **Question** 32 very challenging, even those who scored extremely well on the paper as a whole.

Comments on Specific Questions

Question 3

Over a quarter of candidates thought that the key diagnostic feature for the identification of an insect is the possession of wings rather than the possession of three pairs of legs.

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Question 4

The vast majority of candidates were able to follow the key to arrive at the correct answer.

Question 6

Many candidates demonstrated careful observation and good knowledge of plant cell structure.

Question 8

Less able candidates thought that the role of the cilia lining the trachea is to trap dust particles rather than to move mucus up towards the throat.

Question 17

The link between the absorption of water by plant material and its subsequent conduction in the xylem was not known by just over a fifth of the candidates.

Question 21

About one quarter of candidates thought that plants only respired during darkness rather than continually.

Question 23

Many candidates thought that urea is made in the kidneys rather than in the liver.

Question 26

Many candidates could not distinguish between the plumule and the radicle.

Question 28

Less able candidates chose one of the options with sunlight, not appreciating that seeds usually germinate in the soil where there is no light.

Question 32

This question proved very difficult, even for the most able candidates. The vast majority did not appreciate that there were two distinct groups, each group showing smaller but essentially continuous differences between members of that group.

Question 33

The majority of candidates did not appreciate the non-cyclical nature of the energy flow.

Question 36

Over a third of candidates did not appreciate that faeces contain carbon atoms. (Such as in undigested carbohydrate found in for example cell walls, as well as other organic materials).

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BIOLOGY

Paper 0610/13
Multiple Choice

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

General comments

The test was pitched at an appropriate level for the abilities of the candidates. Only two questions were answered correctly by less than half of the candidates.

Comments on Specific Questions

Question 3

The key diagnostic feature for the identification of an arthropod is the number of legs the organism contains and not the possession or non-possession of wings.

Question 7

Xylem as an example of a tissue was not well known. All responses were seen, the most common incorrect response was organ.

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Question 9

The movement of carbon dioxide in and out of a mesophyll cell by diffusion was not well known. Active transport and respiration were the more common incorrect responses.

Question 15

More able candidates knew that fats are first digested in the duodenum.

Question 22

Many candidates thought incorrectly that the kidney is involved in making urea and so gave **B** as their answer.

Question 24

The majority of candidates incorrectly chose the motor neurone rather than the sensory neurone with very few candidates choosing either of the other two options.

Question 26

This question was answered correctly by the vast majority of candidates.

Question 28

This proved to be a difficult question for many candidates. Less able candidates chose one of the options with sunlight, not appreciating that seeds are usually planted in soil where there is no light.

Question 29

The vast majority of candidates read and interpreted the graph correctly.

Question 33

Many candidates did not appreciate that producers undergo decomposition when they die and so chose only animals to supply energy to decomposers.

Question 39

The majority of candidates knew that carbon dioxide contributes to global warming but many candidates chose sulfur dioxide as the other gas rather than methane.

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BIOLOGY

Paper 0610/21
Core Theory

Key Messages

It is important that candidates read each question carefully and carry out the task required. Mark accessibility is restricted if candidates do not answer the question or do not follow the command words. For example, “state” requires a different type of response to “explain”.

Candidates would also benefit by taking note of the number of marks allocated to each sub-question. For example, if three marks are allotted, then three distinct points need to be made in the answer.

General Comments

Some candidates performed very well, but the majority struggled to answer some of the questions adequately. The standard of English was very good. There was no evidence that candidates were short of time. Specific areas where improvements could be made will be clarified in the relevant sections.

Comments on Specific Questions

Question 1

Few candidates could recall the facts required and many gave numbers for all four answers. More were aware of the difference in venation than knew the difference in petal numbers.

Question 2

(a) (i) Some excellent, clear answers were seen. Others knew that bacteria were responsible, but thought that bacteria attacked the teeth directly. Candidates who performed less well wrote at length about the prevention of tooth decay rather than explaining its causation.

(ii) Most candidates responded well in the first two parts referring to the removal of food remains, bacteria or plaque. The final part proved more challenging and frequently responses did not answer the question.

(b) (i) This was generally well known. The role of the canines was the least understood.

(ii) Many candidates knew that the tongue moved food between the teeth. The most common mis-conception was that the tongue produced saliva, or amylase, or both of these.

(c) Candidates who performed less well gave answers with too little detail or referred to choking and food becoming stuck in the trachea. Better performing candidates said that the surface area would be increased. A minority of candidates stated that digestion would be more rapid.

Question 3

(a) Better performing candidates knew that accurate labelling requires the line to end on the structure being named, and not to point in its general direction. For this reason, a simple line is preferable to one ending in an arrow-head. Most candidates knew the position of the trachea, with the larynx and the bronchiole being less well known.

(b) There were a few candidates who knew this topic. The majority did not comprehend what was required and described what could be seen in the diagrams

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(c) (i) Nearly all candidates carried out the calculation correctly.

(ii) Most candidates did not answer the question and wrote about the heart beating more quickly or the lungs getting larger. Other candidates stated that breathing became faster or deeper, but very few gave both of these answers.

(iii) Many candidates merely rephrased the stem of the question. About a third of candidates gave the response of more oxygen or more energy being required.

Question 4

(a) Candidates who performed less well wasted time and space by explaining the term “deforestation”. The majority of candidates stated only two detrimental effects. Some candidates wasted time writing about the fall in oxygen levels.

(b) Candidates often focused on processes rather than the pollutant named.

Question 5

(a) Many candidates could give a definition of “mutation”. Few knew definitions for “heterozygous” and “recessive allele”. There was confusion between alleles, genes and chromosomes.

(b) Candidates who performed less well merely rephrased the information given to them. Others reasoned that the cream acted as a barrier.

(c) (i) Better performing candidates answered correctly.

(ii) Only minority of candidates identified couple R correctly.

(iii) Those who could identify couple R usually gave sound explanations for their choice.

Question 6

(a) The majority of candidates did not know the structure of a seed. Of those that could recall the facts, many did not include precise labelling.

(b) “Cotyledon” was known by few. Most quoted the name of any plant structure.

(c) About half of the candidates gave a correct explanation. Others thought that seed dispersal was a necessary part of reproduction.

Question 7

(a) (i) Many candidates gave no response.

(ii) The majority of candidates performed well. Some explanations were incomplete; for example, many stated that the reason why the number of crows decreased was because there were more hawks, without stating that hawks eat crows.

(b) This was generally answered accurately. There was some confusion between the definitions of carnivore and herbivore.

Question 8

(a) Most candidates had learnt the definition of an enzyme.

(b) This was very well answered.

(c) There were some excellent responses to this question. Some candidates seemed hampered by not understanding the term “substrate”. A few could give the answers “protein” and “amino acids”, but did not know the other responses.

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Question 9

(a) The majority of candidates confused translocation with transpiration, or stated that translocation involved moving the plant to another place.

(b) The position of the xylem in the root and the stem was known much better than its position in the leaf. As with the other questions involving labelling a diagram, candidates would benefit from including precise labelling. A significant number of candidates labelled the cambium in the leaf and the stem.

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BIOLOGY

Paper 0610/22
Core Theory

Key Messages

Candidates should be aware of the need to read each question carefully. In particular they should make sure they follow the instructions, using the given data or information in their answers.

General Comments

Most candidates attempted all the questions. Careful reading of the questions would ensure that candidates are clear that they understand what the question is asking them to do. A strong area was environmental relationships and an area for improvement was genetics.

Comments on Specific Questions

Question 1

In **Question (a)**, candidates needed to state a characteristic **only** shown by vertebrates. The answer for **(b)(i)** needed examples **NOT** shown in the diagram. Several candidates gave other examples of mammals or birds for **(b)(i)**, rather than fish and reptiles. Their following answer for **(b)(ii)**, was then given as fur or feathers.

Question 2

Most candidates showed a good understanding of digestion and the role of enzymes, although not all answered **(b)** in sufficient detail. In part **(c)** more careful examination of all five of the diagrams was needed, as the labelled dish was also a possible answer. While candidates understood the concept of optimum temperature and rate of reaction in **(d)**, many did not notice that this enzyme was found in the human alimentary canal and therefore 30°C would still be below its optimum. A large number of answers suggested that the enzyme would be denatured.

Question 3

Many candidates showed a good understanding of the excretory system. Many of the names for the parts are very similar and there was a large amount of misspelling in **(a)**. Part **(b)(iii)** was answered very well by most candidates. A comparative answer was required, but a small number of candidates just repeated the data given in the table.

Question 4

A very good understanding of cystic fibrosis, as a disease, was shown. However, candidates did not always read the question sufficiently carefully to give the required answer. **Question (a)(i)** asks for effects on the **person** not just the cilia. In **(a)(ii)** the question states that the tube from pancreas **to** the small intestine is blocked. Some candidates gave answers for the small intestine itself being blocked.

Questions (b) (c) and **(d)** relate to the inheritance of the disease. These questions proved more challenging, as many candidates did not realise that both parents must carry the gene. Very few realised that both children, 1 and 3, will each have two possible genotypes.

It is important to write down a probability in the correct way. Many candidates gave the correct answer of 25%, ¼ or 1:3. The question asks for the probability of **having** the disease, so 3:1 is not correct unless the candidate clearly indicates that the 3 refers to those without the disease.

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Question 5

Most candidates were able to answer all parts of this question. Although clearly labelled as a seed, some labelled the parts of a cell. Most answered **Question (b)(i)** correctly. Although most candidates answered **(b)(ii)** well, some referred to the dispersal of pollen. While most candidates interpreted the diagram for **(c)(ii)** correctly, few understood that light is not required for germination or that respiration rather than photosynthesis will be occurring.

Question 6

Candidates showed a good understanding of food chains and nearly all were able to complete the chain in **(a).** It is important to relate the answer to the food chain specified in the question or to the correct part of the population curve. Sometimes extra information was given, which although correct, did not answer the question.

Question 7

Candidates showed a very good understanding of relationships in the environment. Sometimes candidates find pyramid of numbers and mass confusing, so it helps to remember that **quantity** refers to numbers.

Question 8

Many candidates seemed unclear about the positions of specialised cells in the plant. Nearly all were able to identify a root hair cell, although some were unclear about the role of cell E. In **(b)** they were not being asked how the cells related to each other, but rather how each cell's structure enabled it to carry out its role.

Question 9

Most candidates understood the concept of osmosis even if they had difficulty in describing it. The more clear answers in **(a)** were given in terms of water potential. There were some detailed and correct descriptions of semi-permeable membranes, although this much detail was not required.

Very few candidates were able to complete the table **(b)(i)** correctly. Some did not realise that they had been given the cube length in column 1; others did not multiply the area of one side by 6. Very few understood the significance of the surface-area/volume ratio changing. Even though they understood that increased surface area results in increased diffusion, they did not relate this to time taken.

Question (c) was asking for structural adaptations to the lungs, which help to increase diffusion, not for a description of gaseous exchange.

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BIOLOGY

Paper 0610/23
Core Theory

Key Messages

Read the questions carefully and answer the question asked.

General Comments

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

Comments on Specific Questions

Question 1

(a) Candidates found it difficult to identify features from images in order to name the group to which they belonged.

(b) The most common correct response was that the molluscs had a shell and a slimy skin. Many candidates thought incorrectly that reptiles do not have a backbone or used features that were not listed in the question.

Question 2

(a) (i) Few candidates knew that chamber **B** is the right ventricle.

(ii) Few candidates knew that the blood goes to the lungs after it leaves chamber **B**.

(iii) Approximately half of the candidates knew that blood found in Chamber **C**, the left atrium, has a low concentration of carbon dioxide and a high concentration of oxygen. Some candidates ticked only one box.

(iv) Few candidates knew that the tissue that makes up the wall of chamber **D** is (cardiac) muscle. A common incorrect response was heart tissue.

(b) (i) Very few candidates identified one of the valves and labelled it with a **V**. All parts of the heart were labelled as valves.

(ii) The idea of the valve causing a one way flow of blood or to prevent the blood flowing backwards was not commonly known to candidates.

(c) (i) Many candidates appreciated that the heart speeds up or beats faster or accelerates when a person exercises. More forceful contractions of the heart was rarely seen.

(ii) A whole variety of causes of CHD and reasons why people with this disorder are unable to do much exercise were given by candidates but few gained any credit.

Question 3

(a) Many candidates gained full credit for choosing the correct words about enzymes.

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(b) (i) Many candidates used the graph correctly to determine that 7.5 is the pH at which the enzyme saliva works the fastest. Some candidates gave 7 which was not creditworthy.

(ii) Most candidates used the graph correctly to determine that it takes 4 minutes for the starch to be digested at pH 6.

(iii) Many candidates did not appreciate that the low pH in the stomach due to the hydrochloric acid will denature the enzyme which works best at pH 7.5, as determined in **(b)(i)**. Many candidates repeated the question stem.

(iv) Many candidates appreciated that amylase digests starch but few knew that it is produced in the salivary gland. A common incorrect response for site of production was the stomach.

(c) Few candidates appreciated that temperature can change the rate of enzyme activity.

Question 4

(a) Some candidates could match the diagrams to the type of cell found in the female reproductive system. Many candidates drew more than three straight lines or drew lines which were difficult to follow.

(b) (i) Many candidates gave answers which were too vague to be creditworthy such as they remove or catch anything that goes into the lungs . Answers needed to be much more precise in order to gain credit for example, cilia beat and move the mucus up away from the lungs.

(ii) Candidates found this difficult. Some knew the egg was involved but usually did not know how. Many thought the structures were in the nostrils rather than the oviducts.

(c) (i) Most candidates scored some credit but few scored full credit for oviduct, ovary and uterus. A common error was to mix up oviduct and ovary.

(ii) Few candidates appreciated that the sperm were released at the top half of the vagina / at the base of the uterus / on the cervix. Many put the **X** in the uterus wall or the oviduct. Many candidates omitted this part.

(d) Many candidates knew that the tail of the sperm is used for movement to get to and to fertilise the egg.

Question 5

(a) Many candidates do not understand diffusion and osmosis. There were a significant number who did not complete all eight boxes and those who did generally did not gain much credit.

(b) Candidates found this very difficult. Many could describe what was happening to the small bag of coloured salts in the water but few could relate this information to help explain how tissues obtain oxygen from the blood.

Question 6

(a) Many candidates correctly named one agent of pollination, with wind, insect and a named insect being the most common.

(b) Few candidates could state why fruit and seed dispersal is important for plants in terms which were detailed enough to be creditworthy such as colonising new habitats, preventing overcrowding or reduction of competition. Many gave vague statements such as it's the way they reproduce or it is necessary for plant growth.

(c) Most candidates could use the information given and realised that the means of dispersal was wind but not all of these could give a reason such as the fruits or seeds are light, easily detached, have a large surface area to catch the wind or hairs that act as a parachute.

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(d) Most candidates gained credit for some or all of water, oxygen and warmth. A common incorrect response was light. Many candidates gave more than three environmental conditions which included incorrect conditions thus preventing them from achieving full credit.

Question 7

(a) Many candidates gained some credit. However, many candidates drew more than four straight lines at each side and some joined the left hand side boxes to the right hand side boxes omitting the boxes in the centre. Some drew lines which were difficult to follow.

(b) Few candidates could define the term trophic level. Many gave vague and general comments which were not creditworthy such as the place in the chain of life or the four organisms in a food chain. It was also omitted quite often.

Question 8

(a) (i) Few candidates knew that a population is a group of organisms of one or the same species living in the same place at the same time.

(ii) Some candidates could use the graphs to arrive at the correct answer of 4300 million years but some of these omitted the million. A whole range of answers were given.

(b) Many candidates could describe and understood the reasons why the patterns of population growth in Africa and Latin America were changing.

(c) Many candidates showed a good understanding of the reasons why populations were decreasing.

(d) (i) Most candidates appreciated that the numbers of seabirds increased but failed to realise that there was a decrease followed by an increase and so did not gain credit, whereas they did gain credit for the decrease in woodland birds.

(ii) Many candidates showed good understanding of the reasons why there had been a change in the number of woodland birds since 1990.

(iii) Many candidates appreciated that maintaining food chains and webs is important in conserving species and habitats but other reasons such as their use as a resource, for maintaining biodiversity, their aesthetic value and avoiding extinction were less well known.

Question 9

(a) (i) Few candidates gave a description of inheritance which included being passed from parents to offspring or passed on in the genes or passed on in the eggs and sperm. Many mentioned genes, eggs or sperm but gave vague descriptions about things being passed on or things being obtained.

(ii) Few candidates knew that an allele is an alternative form of a gene and that dominant is the characteristic seen in the outward appearance. Many gave answers in terms of genes from parents and being a capital letter, which were not creditworthy. Some candidates only described the term dominant rather than both terms, dominant and allele

(b) (i) Stronger candidates worked their way through the family tree and gained full credit. When mistakes were made credit for later steps could still gain credit as the error was carried forward but each line needed to correspond with the preceding line. Many candidates did not understand how the genetic diagram should be completed and so gained no credit.

(ii) Those candidates who had worked through the diagram well in **(b)(i)** usually gained credit for working out that all of the children have club thumbs.

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BIOLOGY

Paper 0610/31
Extended Theory

Key Messages

- Candidates should ensure that they read all questions carefully. A number of responses were not specifically directed at the question and although good detail was often included in the answers it could not be credited. Careful attention should be given to the command word in the question. Command words such as 'describe' and 'explain' were frequently misinterpreted.
- Candidates should be encouraged to use precise and correct scientific terminology, especially when prompted by the question as in **Question 4(b)(ii)** which required answers in terms of water potential not concentrations of water.
- Answers should always be written legibly so Examiners can read them. Some scripts were very difficult for the Examiners to decipher and sometimes it is not possible to give the benefit of the doubt to words, phrases or sentences that are impossible to read.
- Numerical answers should always be followed by the appropriate units. Several questions in this paper included information based on data. Answers should be illustrated with figures taken from graphs or tables; no credit is given unless these answers include units.
- Candidates should always be equipped with a black ball point pen, pencil, ruler and electronic calculator. Only diagrams and graphs should be written in pencil. Candidates should avoid writing over pencil answers with a pen. Thick felt pens should never be used as the ink travels through the page and obscures the writing on the reverse side of the page.
- When required to give a simple answer, such as a letter or a number, candidates should not write over a previous answer if they change their mind. First answers should be crossed out neatly and a new answer should be written above or alongside. In cases where an answer is ambiguous, such as a **B** changed to a **D**, no credit can be awarded.
- Candidates should expect questions on experimental techniques and also be expected to make conclusions from experimental data. Some seemed unprepared for **Question 2** that was set on photosynthesis which is a common experiment at this level.

General Comments

This paper included several questions that required candidates to use data and respond at some length. The majority of candidates showed a wide range of knowledge and understanding across the syllabus. Good scripts were characterised by thorough analysis of data, the ability to describe patterns, descriptions of logical sequences of events and good argumentation. Most candidates attempted to answer all the questions and the majority communicated their responses clearly. The extended answers were well structured and ideas generally expressed well. For example, there were many good answers to **Question 6 (b)(ii)** that drew on the ideas of energy flow from Section IV of the syllabus and incorporated the data from the study carried out by Paul Colinvaux in the 1970s. However, some candidates failed to gain full credit due to use of incorrect terminology. This was particularly the case in **Question 3** and **Question 5**.

The question that exposed the least understanding was **Question 2(d)(ii)** where candidates had to explain the greenhouse effect. Few were able to do this confidently. Also, candidates struggled when discussing the social implications of using fertility drugs in **Question 5(e)(ii)**.

Candidates should be encouraged to read through all the part questions of a particular question before answering the first part to ensure that they give the correct type of response in each case. Candidates often wrote the answer to **Question 4(b)(ii)** in answer to **4(b)(i)** and then found that they needed to add to their first answer or cross it out and rewrite it.

Phonetic spellings are always allowed and occasionally some more wayward spellings if the meaning is obvious. However, in this series there were spellings of technical words that were difficult to decipher. Some candidates didn't use or understand the conventional language of Science, for example, capillaries

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were often unable to 'cope' or 'handle' high blood pressure and in response to the question 'draw a food chain' some candidates drew thumb nail sketches of willow trees, a moose and a wolf.

There was no evidence that candidates had trouble completing the paper in the permitted time.

Comments on Specific Questions

Question 1

(a) Most candidates completed the identification key correctly. A few candidates put letters in all the spaces suggesting that they were unfamiliar with using simple dichotomous keys. A common error was to confuse the molluscs identified as **E** and **B**. Many candidates also reversed **B** and **C**.

(b) The most common correct features of molluscs were muscular foot and unsegmented body. The answer 'muscular feet' was ambiguous and was ignored as individual molluscs do not have feet. Several features shown by some molluscs, such as tentacles and eyes, were not credited. Many candidates also referred incorrectly to all molluscs as having shells. There were many 'moist bodies' rather than slimy bodies or soft bodies.

Question 2

(a) (i) Many candidates realised that it was necessary to control the temperature of the water in the beaker although answers were not always well expressed. Some candidates did not explain why the thermometer was included or thought that it was the thermometer that was responsible for maintaining the temperature. Some candidates explained that the beaker of water was necessary to provide water for photosynthesis rather than for maintaining a constant temperature. Relatively few candidates appreciated that it was necessary to prevent temperature influencing the results. A smaller number of candidates attempting to write about temperature as a controlled variable referred to a 'fair test' rather than give a suitable statement about a variable.

(ii) As in part **(a)(i)**, many candidates realised that the light intensity should be kept constant, although many stated that the light meter was the source of the light, not the lamp. Many knew that the ruler was to measure the distance between the lamp and the plant, but fewer went on to say so that it was kept the same throughout the investigation. Candidates sometimes referred to 'light' or to the 'amount of light' rather to light intensity.

(b) (i) Generally very well answered; candidates who used data from **Fig. 2.2** including the units from both axes tended to gain full credit for describing the effect of increasing carbon dioxide concentration on the rate of photosynthesis. Some candidates misread the figures from the graph or did not refer to the key concentrations of 0.1% and 0.4% in their descriptions. Many candidates did not include any units in their answers and so could not be given much credit. Most candidates were able to attain partial credit for a qualitative description of the trend without using any of the data at all. Weaker candidates described the shape of the graph, for example as S-shaped, instead of describing the relationship between carbon dioxide concentration and the rate of photosynthesis. Some candidates confused the dependent and independent variables, describing changes in carbon dioxide concentration as though these were dependent on the number of bubbles produced. Some also interpreted the horizontal part of the graph as a point where photosynthesis is no longer occurring, for example by writing 'photosynthesis stops after 0.40%'. The rate of photosynthesis is not zero between 0.4% and 0.5% as the line remains at 20 rather than decreasing to 0 bubbles per minute.

(ii) Candidates gave all possible factors that could influence the rate of photosynthesis including light intensity, temperature and water. Many candidates missed the importance of carbon dioxide *concentration* in the information at the start of the question and wrote simply 'carbon dioxide' which was not credited.

(iii) Many answers took their cue from the question to part **(b)(ii)** and included good references to limiting factors. Partial credit was given for the use of the term *limiting factor* within the answer as well as to the two limiting factors, light intensity and temperature, that are most likely to be responsible for the constant rate of photosynthesis in region **Y** of the graph at carbon dioxide concentrations between 0.4% and 0.5%. Many candidates explained that carbon dioxide

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concentration is not the limiting factor. Fewer candidates explained that light provides the energy for photosynthesis, but a number suggested incorrectly that the structure of the plant itself would limit the rate that was possible. In doing this they often referred to the chlorophyll content. Very few candidates referred to temperature influencing the activity of enzymes. Again, many candidates referred to 'light' rather than to 'light intensity' as a limiting factor.

(c) Most candidates gave a method for measuring the volume of gas as an improvement to the way in which the rate of photosynthesis was measured. Most often this involved using a gas syringe attached to the apparatus by a delivery tube. Diagrams were occasionally included, but were often unlabelled. Other methods usually involved downward displacement of water in a test-tube or measuring cylinder. Few stated that the gas should be collected over a suitable time period. The use of oxygen sensors or data loggers was rarely seen. Common errors included the use of a gas jar to collect the gas, naming the gas collected as carbon dioxide and using a balloon as a collecting device. Some candidates stated that they would use a potometer which could not be credited. However, some described what read like a description of a potometer, but was often an Audus photosynthometer. Those who drew this apparatus made it clear in their diagrams that they were not referring to a potometer and so gained credit.

(d) (i) Most candidates gave two reasons for the increase in carbon dioxide concentration, shown in **Fig 2.3,** referring to increases in the combustion of fossil fuels, increase in industrialisation or motorised transport and deforestation. Many candidates offered examples and detailed explanations that were not required. The link between increased combustion of fossil fuels and the increase in carbon dioxide concentration was widely known, and while deforestation was a common response, the burning of forests was rarely mentioned. Some candidates referred to the increase in the human population and/or numbers of domesticated animals as significant sources of carbon dioxide, this idea was not credited.

(ii) Candidates displayed a number of misconceptions about atmospheric pollution. Most candidates thought that either carbon dioxide forms the ozone layer in the atmosphere or that it is responsible for the destruction of ozone and the increased penetration of ultra-violet radiation rather than the reduction in loss of infra-red radiation from the Earth to outer space. Some also thought it responsible for acid rain. Stronger candidates knew that carbon dioxide is a greenhouse gas and went on to explain that the gas traps the infra-red radiation emitted by the Earth so that it does not escape from the atmosphere. Some candidates included the greenhouse effect in their answers and some used the term *enhanced greenhouse effect* correctly. Candidates were generally not clear about the terms 'reflection' or 'radiation', often confusing the two and they often discussed 'light' instead of infra-red radiation or heat. Many candidates gave a description of global warming which did not gain credit.

Question 3

(a) Sequencing the events that occur during the menstrual cycle proved difficult for many candidates. Both sequences **KMJON** and **KMOJN** were accepted. A common error was the reversal of **J** and **N**.

(b) (i) Almost all candidates gave a correct definition of ovulation. The only common error was the statement that an 'ovule' is released from the ovary. A small minority of candidates referred to the production of ova rather than their release. Several gave a very detailed description of the hormones involved in controlling ovulation and not what happens to eggs. Several candidates were under the impression that ovulation is the 'release of the follicle'.

(ii) Most candidates named the cell produced at fertilisation as the zygote, occasionally misspelling it as 'zygot'. A minority stated that it was the diploid cell which was not credited.

(c) Some candidates gave excellent answers describing the different developmental stages from zygote to embryo and beyond. Some candidates described the pathway taken by the embryo through the oviduct to the lining of the uterus and implantation. A smaller number described the hormonal changes instead and generally showed an impressive knowledge of the roles of progesterone. There was confusion between the terms zygote, embryo and fetus with zygotes implanting in the lining of the uterus being a common mistake. Some candidates stated incorrectly that zygotes and embryonic cells divide by meiosis. Many gave detailed descriptions of the events after implantation and so were not credited other than for the development of the placenta. .

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(d) Strongest candidates identified both the corpus luteum (yellow body) and the placenta as places where progesterone is produced during pregnancy . Many candidates correctly identified one of these. Ovary was accepted as an alternative to the corpus luteum. A common error was to name the pituitary body as a site of production of progesterone.

(e) (i) Many candidates knew about the uses of FSH, LH and progesterone as fertility drugs, although the syllabus does not state any by name. Some knew that one fertility drug inhibits the action of oestrogen so stimulating the pituitary to release more FSH (this is the drug clomiphene). Answers tended to be very general, including stimulating follicles to develop and increasing the number of eggs released at ovulation. Those who referred to progesterone gave suitable answers about the maintenance of the endometrium. Only a few candidates stated that drugs to stimulate the development of follicles are given early in the menstrual cycle. There was a lot of confusion over the effect of each hormone and also some confusion with the contraceptive pill. Many said that fertility drugs increase the number of times a woman ovulates each month or 'increases ovulation' without saying what that meant. A few candidates stated incorrectly that fertility drugs are used for men explaining that they increase sperm production.

(ii) Most of the answers given to this question about social implications of using fertility drugs dealt with purely medical consequences and so did not gain any credit. Candidates who stated that fertility drugs increase the chances of multiple births did not usually develop this idea to refer to the problems that families may have coping with two or more children born at the same time. Stronger candidates pointed out that if treatment with fertility drugs alone is successful there is no need for more expensive treatments such as IVF. Some candidates thought about effects on the birth rate, usually in terms of *increasing* an already large population. However, there are countries where the birth rate has fallen considerably in recent years and the demand for fertility treatment may increase as women leave childbirth until their 30s or even their 40s. Some candidates raised the issue of elderly parents as one of their social implications and many mentioned religious objections although rarely by saying more than a variation on 'religions object'. Many candidates referred to physical effects on the woman and also mental effects, such as mood swings and unspecified side effects.

Question 4

(a) Most candidates identified the nucleus **C** in **Fig. 4.1** and also identified **A** as the cell wall, cell membrane was a common error. The site of chemical reactions of the cell including protein synthesis should have been identified as **D,** cytoplasm. Many candidates gave **B** which was named as ribosomes and mitochondria. Neither of these cell structures is visible in **Fig. 4.1** and ribosomes are the site of protein synthesis and mitochondria are the site of aerobic respiration. **B** is the vacuole in the cell.

(b) (i) Many candidates gave thorough answers although some gave explanations for the changes visible in **Fig. 4.2** rather than descriptions. Credit was given for the decrease in size of the cytoplasm and for a description of plasmolysis. The common response the 'cell shrinks' was accepted although 'cell contents shrinks' would have been a better answer. There was evidence of misunderstanding as some candidates stated that the spaces between cytoplasm and cell wall are filled with air rather than with salt solution diluted by water diffusing out of the cell. Some candidates stated that the cells are flaccid or are no longer turgid but more candidates reversed this insisting that water entered the cell.

(ii) Many candidates gave good answers that used the terms water potential and osmosis, correctly stating that water moves out of the cell through the partially permeable membrane. A variety of alternatives were accepted for partially permeable such as semi-permeable and selectively permeable. Weaker candidates often had water travelling the wrong way between areas of high and low water potential. It was fairly common for candidates to give the definition of osmosis without referring to the example in the question. Some candidates repeated their answer in part **(ii)** often without returning to part **(i)** to change that answer from an explanation to a description. Many candidates referred incorrectly to the movement of salt rather than the movement of water. The most common error amongst the weaker candidates was referring to 'water concentration' rather than to water potential.

Question 5

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(a) Many candidates appreciated that in a double circulation blood travels twice through the heart in one complete circuit of the body but many did not give the second part of the definition stating only that blood goes through the heart twice. Some candidates wrote about the two circulations, pulmonary and systemic, and gained credit. Others stated that blood is either oxygenated or deoxygenated which was not sufficient to gain any credit.

(b) **Table 5.1** was completed fully by many candidates and many candidates identified all eight blood vessels successfully. The least well known were the hepatic portal vein and the blood vessels to and from the heart, these were often either named incorrectly or omitted. A few candidates gave the coronary artery as an alternative to vena cava in the first row of the table and this was credited. A common error was confusing hepatic portal vein with 'hepatic portal artery'.

(c) (i) There were many correct explanations for the presence of arterioles in the circulation system. Candidates usually stated that the capillaries are thin and will burst if blood at high pressure passes into them. A common error was to state that capillaries have thin *cell* walls, rather than stating that their walls are one cell thick. Many candidates misinterpreted the question and gave answers explaining that blood must be at a lower pressure to allow diffusion of substances.

(ii) Almost all candidates explained that valves in the femoral vein prevent backflow of blood, although some thought that it is the valves that push the blood. Most went on to explain that it is contraction of leg muscles that squeeze the veins and force blood along. Some candidates described the development of negative pressures in the thorax and in the heart and also the idea of residual pressure from the heart. Some confused the wall of the vein with the skeletal muscles of the leg and thought that the movement is the result of peristalsis by muscles in the vein.

(d)

To gain full credit for explanations of the relationship between the structure and function of the artery, candidates could give two structural features and explain the functional significance of one of these, which many did. Candidates commonly referred to the thickness of the wall and its muscle and elastic tissue. Many also referred to the narrow lumen although this was not visible in **Fig. 5.1**. The most common error was that the muscle in the wall of the artery contracts to force blood along much as peristaltic muscles move food in the gut. A few candidates referred to narrow lumen increasing the pressure rather than maintaining it. Another common error was to say that the artery has a wide lumen to allow lots of blood to flow through it. The purpose of the recoil of elastic tissue was given by very few.

Question 6

(a) (i) Many candidates gave a food chain with three organisms, although many put the two producers named in the question together which was accepted. Some drew a mini food web with two lines pointing towards the herbivore and these did not gain full credit as the organisms needed to be arranged in a linear sequence as a food chain with the arrow pointing from food to feeder. Quite a large proportion of candidates had the arrows pointing in the opposite direction. A few candidates introduced their own organisms, such as grasses, foxes and the occasional lion or cheetah to their food chains.

(ii) A variety of answers were accepted for the trophic levels but the best answers were producer for the willow and aquatic plants, primary consumer for the moose and secondary consumer for the wolf. Some candidates named the moose as the secondary consumer possibly because it is the second trophic level. The terms herbivore and carnivore were not creditworthy as they are not names given to trophic levels.

(iii) Candidates gave a range of factors that can affect the population of a top predator and a lengthy list is in the mark scheme. By definition this excludes predation, but includes the wolves' food supply and the food eaten by moose. Partial credit was given for food, however described, and other factors such as disease, hunting or poaching, suitable habitats and competition were all seen commonly. The latter could include competition with other top predators of the same species or other predators.

(b) (i) Candidates tried every possible way to manipulate the figures in **Table 6.2** to derive the percentage of energy obtained by moose that is consumed by the wolves in the study carried out on Isle Royale. There are two creditworthy methods.

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Method 1: calculating the energy intake (56 000 MJ) as a percentage of the energy consumed by moose (4 320 000 MJ); giving an answer of 1.3%
Method 2: calculating the energy intake (56 000 MJ) as a percentage of the energy consumed by the moose minus the energy loss in respiration;); giving an answer of 1.4%. Candidates who showed their subtraction gained partial credit if they then did not calculate the percentage correctly
Answers should be expressed to two significant figures but answers given to three were accepted. Unfortunately, some candidates appeared not to have electronic calculators as they showed their working, but did not calculate the percentage.

(ii) Some candidates appreciated the implications of the energy transfer that they calculated in part **(b)(i)**, but many did not and referred instead to the transfer of 10% of energy from moose to wolves and/or the loss of 90% of energy by moose. Very few referred to the previous calculation and so failed to take the hint to use their knowledge of energy flow.
Some candidates explained the relative numbers by describing the relationship between predators and prey that occurs in simple food webs like the famous example of snowshoe hares and Canadian lynx. Even though the actual relationship between wolves and moose is more complex than a simple predator-prey relationship, credit was given for argumentation based on this principle.
Candidates who gained full credit almost always started with the idea that energy is lost between trophic levels. These candidates gained credit by explaining the energy losses from the moose in terms of respiration, movement, excretion and egestion. Many candidates discussed the poor performance of wolves as predators and highlighted the difficulties they have in catching moose which is almost their only food supply. Many misinterpreted the question and gave answers discussing factors that could have caused the wolves to die such as disease, hunting, unsuitable habitat, competitor predators or a predator of wolves. Many candidates did not use the information given in the question and discussed the impact of humans on the control of the wolf population perhaps by hunting or the fact that the environment may not be suitable for the wolves. Also, some gave lengthy descriptions of how natural selection is keeping the number of wolves low, or a supposed low rate of reproduction of wolves and high rate of reproduction for moose.

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BIOLOGY

Paper 0610/32
Extended Theory

Key Messages

- Candidates should ensure that they read all questions carefully. A number of responses were not specifically directed at the question and although good detail was often included in the answers it could not be credited. Careful attention should be paid to the command word in the question.
- Candidates should be encouraged to use precise and correct scientific terminology. Phrases such as 'the light would *affect* photosynthesis' or the 'homes of organisms' do not earn credit. Antibodies should not be confused with antibiotics, and similarly fibrin should not be confused with fibre.
- Numerical answers should always be followed by the appropriate units. Several questions in this paper included information based on data. Answers should be illustrated with figures taken from graphs or tables; no credit is given unless these answers include units.
- Comparative data quotes should include two complete sets of data with readings from both axes at key points on a graph or in a table.
- Candidates should always be equipped with a black ball point pen, pencil, ruler and electronic calculator. Only diagrams and graphs should be written in pencil. Candidates should avoid writing over pencil answers with a pen. Thick felt pens should never be used as the ink travels through the page and obscures the writing on the reverse side of the page.
- When required to give a simple answer, such as a letter or a number, candidates should not write over a previous answer if they change their mind. First answers should be crossed out neatly and a new answer should be written above or alongside. In cases where an answer is ambiguous, such as a **B** changed to a **D**, no credit can be awarded.
- Candidates should expect questions on experimental techniques and also be expected to make conclusions from experimental data. Some seemed unprepared for **Question 2** which was set on an experiment on photosynthesis.

General Comments

Most candidates were very well prepared and able to answer both the factual recall questions as well as those questions that required them to apply their knowledge or interpret data. Few, if any, questions were omitted, shortage of time was thus not a concern.

Comments on Specific Questions

Question 1

(a) Most candidates used the dichotomous key to identify the flowering plants in Fig. 1.1. The most common mistake was to identify **A** as *Triticum aestivum* and **D** *as Zea mays*.

(b) Most candidates named a feature used to distinguish monocotyledonous plants from dicotyledonous plants. However, a number of candidates referred to venation even though this feature was stated in the question. Additionally, there were references to roots and the numbers of flowers rather than references to flower parts or to named parts, such as petals. Some also identified features of wind and insect pollination such as nectar and brightly coloured petals which were not relevant here.

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(c) (i) Some candidates gave very detailed answers with soil erosion being the most frequently seen correct consequence of deforestation on soil ecosystems. It was pleasing to notice that few candidates used vague terms such as 'affect' and 'change' in their descriptions of disrupted food chains. Many candidates appeared not to see the command word *describe* in the question and went into unnecessary detail explaining how different effects were caused.

(ii) The sequence of events during paper recycling was less well known and most responses lacked detail of the process. Many candidates misunderstood the term recycling and instead wrote about reusing paper by writing or printing on both sides or using discarded paper for arts and crafts.

Question 2

(a) Most candidates wrote the correctly balanced chemical equation for photosynthesis. Candidates should be advised to write the formula in the correct format with the numbers of atoms as a subscript and not a superscript or a number alongside the symbol. A common error was six molecules of glucose produced. Occasionally the equation for respiration was given. Some candidates gave word equations rather than the balanced chemical equation.

(b) Only those candidates who perhaps had practical experience in measuring rates of photosynthesis realised the significance of the glass tank as a heat filter in this investigation. Many thought the tank was necessary to disperse the light and some wrongly linked the water to the natural habitat of the algae.

(c) Many candidates found predicting the colour of the indicator solution and explaining their reasoning a challenge. Many identified that photosynthesis was involved, but few mentioned the uptake of carbon dioxide or that carbon dioxide was an acidic gas and the effect that this would have on pH. Several assumed that oxygen or glucose were alkaline or bases, while some described carbon dioxide being produced and lowering the pH. Very few discussed photosynthesis having a higher rate than respiration.

(d) Most candidates were able to describe the data in **Fig. 2.2** thoroughly, but many did not include an explanation of the observed trend. Some candidates did not include units in their use of comparative figures and others did not use two complete comparative data sets. It was rare to see the candidates referring to light as a limiting factor. The link between light intensity and the rate of photosynthesis was well described, although few candidates mentioned the plateaux at both ends of the graph or the lack of change in rate when the algae were close to the lamp, both of which resulted from limiting factors other than light intensity. A small number managed to make the connection between distance and light intensity. Some candidates referred to the role of chloroplasts or chlorophyll, but few identified that light provides the energy for photosynthesis in the algae.

Question 3.

(a) Almost all candidates knew the function of red blood cells, although a few linked them incorrectly to transporting other nutrients in the blood as well oxygen.

(b) (i) Most candidates were able to describe confidently the function of the nucleus, drawing on ideas from various parts of the syllabus. A few candidates described the nucleus as the 'brain of the cell' which is not creditworthy.

(ii) Many candidates understood the main advantage for the lack of a nucleus in human red blood cells, but many incorrect responses were also seen. The use of 'surface area' in the explanation suggested a misconception as to where oxygen is carried and was not credited. Few linked the lack of a nucleus to the ability of the red blood cells to be more flexible.

(c) (i) A small number of candidates misread this question and attempted to explain, rather than describe, the difference in the appearance of the red blood cells in the two salt solutions. Common errors were references to turgidity and plasmolysis.

(ii) Many candidates realised that the movement of water molecules by the process of osmosis was the reason for the bursting of red blood cells in the dilute salt solution. However, quite a number referred to movement of salt rather than to the movement of water molecules. A large number

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failed to make reference to water potential or to membranes. Reference to water concentrations and concentration gradients were not credited as the principle of water potential should be used for explanations of water movement into and out of cells or tissues.

(iii) Most candidates explained that it was the presence of the cell walls that would prevent plant cells in a dilute salt solution from bursting. However, a minority also considered the possibility that there may have been no net water movement if the cells were surrounded by an intercellular solution with a water potential identical to that of the cells.

(d) (i) Applying their understanding of the results from the experiment on osmosis to fluid replacement after blood loss was answered confidently by many candidates. A number of candidates omitted units or used incorrect units and so did not gain full credit.

(ii) Most candidates knew that platelets are involved in blood clotting. Well-prepared candidates gave some very thorough descriptions of the process including many details well beyond the detail required by the syllabus.

Question 4

(a) (i) Since bronchioles would technically not be seen without the use of a microscope 'bronchus' or 'bronchiole' was accepted as the label for structure **K**. Phonetic misspellings were credited.

(ii) Candidates found this question challenging. Many candidates did not state clearly that the two cell types have different functions. Often candidates described what happens in the trachea with no reference to goblet cells or ciliated cells. When the two cell types were mentioned the functions were often described in such vague terms that they could not gain credit. A large minority of candidates also stated incorrectly that cilia filter air by trapping dust and bacteria, and sometimes linked cilia with increased surface area for gas exchange. Some candidates referred to *ciliated cells* moving up the trachea rather than cilia beating to move mucus; several candidates referred incorrectly to cilia moving by peristalsis. The 2016 syllabus will require candidates to write more extended responses without prompts as in this question.

(b) (i) Many candidates gave good descriptions of the diffusion of oxygen molecules from the alveoli into the blood with a moist lining mentioned by many stronger candidates. Many candidates referred to a concentration gradient for oxygen, but did not state that the gas moves by diffusion from alveolar air into the blood.

(ii) The mechanism of inspiration was described in detail by well-prepared candidates, many of whom gave more points than the maximum number of marks required. Several candidates described the pathway taken by air into the gas exchange system rather than describing the movements of the diaphragm and rib cage during inspiration.

(iii) Carbon dioxide was the most common correctly named gas that is found in a higher concentration in expired air than in inspired air. Water vapour was rarely given.

(c) Although many candidates gained full credit for correctly naming two components of tobacco smoke that affect the gas exchange system, many did not gain the marks for the effects of them. Nicotine does not affect the gas exchange system and was thus not creditworthy. Cancer was also often wrong associated with carbon monoxide.

Question 5

(a) (i) Only the most able candidates sequenced the events between fertilisation and birth correctly. The most common error was to reverse the order of **V** and **W** and/or **S** and **T**. In a few cases, candidates wrote over their original answer, making it impossible to know which letter was their final answer and hence no credit could be given.

(ii) Although most candidates gained some credit for identifying the structures in **Table 5.1** and matching these to their names and functions, only a minority completed all five correctly; for example, it was common to see the amnion providing nutrients. A common mistake was to identify the uterus as the uterus lining. Many candidates also struggled with the spellings of these structures, phonetic spellings were credited where there was no confusion with another technical term.

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(b) Almost all candidates identified one similarity and one difference in the composition of breast milk compared with formula milk. The most common error was to describe the difference in the volume of milk consumed rather than the nutritional value.

(c) (i) Very thorough definitions of growth using the key points stated in the syllabus were given by the vast majority of candidates. Most referred to a permanent increase in dry mass.

(ii) Many candidates drew information from the two different sources (**Table 5.2** and the graph in **Fig. 5.3**) to describe and explain the changes in the mass of babies fed the two types of milk. Weaker candidates quoted data without commenting on the trend; although many could identify that there was more protein in formula milk few linked this to growth of the babies. A common error was to suggest explanations beyond what was evident from the data.

(iii) Many candidates described both advantages and disadvantages of breast-feeding. However, many misconceptions were also seen. Many candidates assume incorrectly that lower growth rate in breast-fed babies was unhealthy; only a very small number made a link with bottle-feeding and childhood obesity. A common answer suggested that mothers could not feed in public, rather than suggesting that they may be embarrassed to do so. Candidates who made mistakes often referred back to data from the previous question, for example by stating that low protein content was a disadvantage of breast-feeding.

Question 6

(a) Almost all candidates were able to name the log or exponential growth phase. A significant number of candidates identified this as the lag phase. Candidates need to write clearly when giving technical terms that can easily be confused, such as log phase and lag phase.

(b) Only the most able candidates applied their knowledge to describe in sufficient detail to gain full credit the consequences of excess fish pieces reaching natural water. A number of students identified a possible growth of microbial populations often linked to decomposition and sometimes a depletion of oxygen. Many answers were too vague to gain credit, for example ‘contaminated water kills animals and plants’.

(c) Many candidates identified the lowest possible trophic level for the salmon. However, many candidates did not understand the term trophic level and identified the lowest level as ‘fish pieces’.

(d) Stronger candidates gave detailed explanations as to why eating seaweed rather than salmon would be more energy efficient. Weaker candidates had less understanding of energy flow. Some candidates referred to the benefits of growing seaweed as opposed to salmon in terms of ease for the grower or farmer.

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BIOLOGY

Paper 0610/33
Extended Theory

Key Messages

- Candidates should ensure that they read all questions carefully. A number of responses were not specifically directed at the question and although good detail was often included in the answers it could not be credited. Careful attention should be paid to the command word in the question. Command words such as 'describe' and 'explain' were frequently misinterpreted.
- Candidates should be encouraged to use precise and correct scientific terminology. Phrases such as 'the temperature would *affect* photosynthesis' or the 'homes of organisms' do not earn credit.
- Numerical answers should always be followed by the appropriate units. Several questions in this paper included information based on data. Answers should be illustrated with figures taken from graphs or tables; no credit is given unless these answers include units.
- Comparative data quotes should include two complete sets of data with readings from both axes at key points on a graph or in a table.
- Candidates should always be equipped with a black ball point pen, pencil, ruler and electronic calculator. Only diagrams and graphs should be written in pencil. Candidates should avoid writing over pencil answers with a pen. Thick felt pens should never be used as the ink travels through the page and obscures the writing on the reverse side of the page.
- When required to give a simple answer, such as a letter or a number, candidates should not write over a previous answer if they change their mind. First answers should be crossed out neatly and a new answer should be written above or alongside. In cases where an answer is ambiguous, such as a **B** changed to a **D**, no credit can be awarded.
- Candidates should expect questions on experimental techniques and also be expected to make conclusions from experimental data. Some seemed unprepared for **Question 2** that was set on an experiment on osmosis.

General comments

There were very few cases where candidates failed to attempt a whole question and little evidence that candidates had insufficient time to complete the paper. Longer answers, such as those in **Questions 3(c)** and **5(c)(iv)**, were generally well structured with those candidates who wrote in continuous prose rather than in bullet points usually including appropriate detail and thus gaining much credit. Many candidates were able to draw on their own local experience to provide valid examples of causes for possible extinctions (**Question 1(b)**) and the benefits for integrated farming (**Question 6 (c)**). However where it was necessary to recall detailed knowledge correctly, a lack of precision was evident. Examples included aspects of excretion (**Question 4(a)(i)**, **(a)(iii)**), the structure of the kidney (**Question 4(b)**) and details of human reproduction (**Question 5 (a)(i)**, **(a)(ii)**, **(b)(i)**, **(b)(ii)**, **(c)(ii)** and **(c)(iii)**). The term *water potential* (**Question 2(b)**) described only in the extended syllabus, was poorly understood by a considerable number of candidates with many not realising the connection to osmosis and the movement of water molecules across partially permeable membranes. The lack of the correct use of key terminology was often the main cause of a lower score in an otherwise able candidate.

Comments on specific questions

Question 1

(a) Most candidates completed the identification key correctly. A few candidates put letters in all the spaces of the right hand column suggesting that they were unfamiliar with using simple dichotomous keys. A common error was to confuse the amphibians identified as **A** and **F**.

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(b) This question was answered well with many candidates giving insightful suggestions as to why amphibians might be endangered. Many answers made relevant reference to local situations showing consideration of the problems specific to amphibians. Repetition or elaboration of the same point, for example pollution, prevented some candidates from gaining full credit. Some candidates used the colloquial word 'homes' rather than referring to the animals' habitats. Another common error was to suggest factors that may cause the death of an individual amphibian, but would not be a cause for the potential extinction of a whole species, for example falling prey to their natural predators and competition for mates.

Question 2

(a) (i) All potential marking points were seen, but references to carriers, channels or pumps were infrequent. Most candidates gave features of diffusion that are not applicable to active transport but, where candidates clearly stated that their answers were given in terms of active transport instead, these were also credited. Some candidates used the phrase 'along a concentration gradient' instead of 'down' or 'against' which did not gain credit.

(ii) Almost all candidates knew that root hairs are an adaptation for the absorption of ions. In addition, many discussed the extensive branching of roots and their large surface area. Only the more able candidates realised that ions are absorbed by active transport and thus described the role of carrier molecules and the large vacuole in this process.

(b) (i) Many candidates calculated the percentage change in mass correctly but there was a minority who did not attempt this question. Those candidates who did not obtain the correct answer were able to gain partial credit if their working was shown and was correct, highlighting the importance of showing all working. The extensive arithmetical workings of a small number of candidates suggested that they did not have an electronic calculator.

(ii) Only the most able candidates were aware of the reasons for percentage change calculations such as the one they performed in **(b)(i)**. The idea that the onions had a different starting mass and therefore the calculation of percentage change in mass allowed results to be compared was rarely stated. A number of candidates gave vague answers suggesting that they had some idea about this concept but they did not express their ideas clearly enough to be creditworthy.

(c) (i) Candidates needed to complete the graph using their own calculated values from **(b)(i)**. Even if an incorrect value had been calculated, this error was carried forward, enabling all candidates the opportunity to gain credit for correct plotting. Most candidates plotted their data correctly, but a minority were confused by the minus sign in front of the value or extrapolated the trend line beyond their data point.

(ii) This question was straightforward for those candidates who were familiar with how water potential can be derived graphically from reading the intercept with the *x*-axis. However, some candidates gave a wide range of guesses at the value. A number of candidates who had correctly found the value omitted the units and thus did not gain full credit.

(d) Almost all candidates used the term water potential in their answers with stronger candidates showing understanding of the term. Of those who understood the term, comparative statements between the water potential of the onion bulbs and the solutions were sometimes lacking; stating that water potential was high or low was usually too vague to gain credit. Although the more able candidates knew that change in mass was caused by the movement of water in and out of the onion cells, a considerable number incorrectly attributed this to the movement of the 'solution' or even the 'salt'. A few candidates also did not understand that osmosis applies only to water and very few made reference to the partially permeable membranes.

Question 3

(a) Although most candidates attempted to use data from the graph to compare the two batches of tree leaves, many seemed unsure of what the graph was showing. Many candidates implied that the *x*-axis was time rather than temperature, with statements suggesting that batch **J** peaked later than batch **H**. Additionally, references to data were not always precise and/or comparative in otherwise good answers.

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(b) (i) Most candidates understood that temperature was the limiting factor however, few went on to explain why temperature has such an effect. Only a minority mentioned that the stomata would open wider and therefore more carbon dioxide would be taken into the leaf. Comments rarely involved the use of enzymes or the frequency of collisions between enzymes and substrate molecules. Many attempted to explain the effect on the process of photosynthesis rather than the effect of temperature.

(ii) Most candidates mentioned the consequence of high temperatures on enzymes and stated that their activity at high temperatures would decrease or stop. The term *denatured* is only relevant to enzymes and not to cells or photosynthesis. Few mentioned the closing of stomata.

(c) Almost all candidates mentioned an increase in plant growth and increase in photosynthesis although sometimes these were too vague to be credited. Fewer candidates went on to explain the consequences of this in the form of increased production of glucose, energy for cells or proteins for enzymes. References to greenhouse gases and global warming were seen but the consequences were less well understood or stated. Weaker candidates did not realise that carbon dioxide uptake measured in the experiment equated to the rate of photosynthesis and thus found this question demanding. This is an extended response question and answers were generally too brief or covered the same points numerous times.

Question 4

The excretory functions of the liver and kidney were examined in this question. The kidney was generally well understood, the excretory role of the liver was not.

(a) (i) Many definitions of excretion were limited or vague and so not creditworthy. Many candidates did not describe the removal of waste from the body and confusion of excretion with egestion was very common.

(ii) Almost all candidates identified carbon dioxide as an excretory product that is passed out through the lungs.

(iii) The liver was frequently associated with 'filtering' the blood or 'excreting' toxins or alcohol, neither of which is correct. Good answers that included references to deamination, production of urea and the breakdown of toxins were rare. A few candidates described the production of bile, which could not be credited as they did not mention bile pigments which are the excretory products.

(b) Most candidates named and identified the blood vessels carrying blood to and from the kidney. The rest of **Table 4.1** was often incomplete. Very few candidates identified **K** (cortex) as the region where blood is filtered. A significant number of candidates were able to identify the structure on the diagram from its function, but no credit could be awarded because they did not know the names of the structures. The spelling of ureter was important so that there was no confusion with urethra.

(c) (i) A wide variety of correct answers were given; salts, urea, and toxins were the most common. A few candidates thought incorrectly that carbon dioxide, amino acids or glucose were removed during dialysis.

(ii) Candidates answered this very well. They were aware of the time constraints on people having dialysis as well as the restricted diets. Many also mentioned the possibility of rejection of the kidney and many stronger candidates mentioned the need to take immunosuppressants as disadvantages of kidney transplants.

Question 5

(a) (i) Many candidates seemed unfamiliar with the sequence of changes within the ovary during the menstrual cycle and thus were not able to identify structures **R** and **S** as the corpus luteum (yellow body) and the follicle.

(ii) Ovulation was generally identified correctly but was occasionally confused with menstruation.

(b) (i) Although the majority of candidates knew that oestrogen stimulated the growth of the uterine lining, the other three reproductive hormones were seen regularly.

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(ii) Most candidates named progesterone as the hormone involved in the maintenance of the uterine lining but as with **(b)(i)** it was confused with the other reproductive hormones. Some spellings were poor but phonetic spellings were accepted. A few candidates gave FSH as an answer to both parts of **(b)**.

(c) (i) The differences between sperm and eggs were generally well known. The most common responses being sperm have tails, are motile and are smaller than eggs. Most candidates achieved full credit, but some was lost for failure to make comparative references to the size of the gametes or to suggest that the individual sperm would contain either X or Y chromosomes. Those candidates who referred to the site of production or numbers produced gained no credit as these are not differences between the two cell types.

(ii) Many candidates knew that haploid is the term that describes the number of chromosomes in the gametes, but many incorrect responses were also seen. A small minority gained no credit because they wrote 'haploid and diploid' and hence contradicted themselves.

(iii) The vast majority of candidates believed that fertilisation occurs in the uterus, ovary or vagina, rather than in the oviduct. 'Ovary duct' was not accepted, although phonetic spellings of oviduct or Fallopian tube were accepted.

(iv) Stronger candidates recounted the events between the sperm reaching an egg and implantation using correct technical terms. Many knew that only the nucleus of the sperm enters the egg cell and that following this a fertilisation membrane forms preventing other sperm from entering. Many knew that a zygote forms, but there was a tendency for weaker candidates to mention meiosis of the zygote instead of mitosis. The best answers included description of movement, using cilia or peristalsis, in the oviduct.

(d) (i) Most candidates described correctly the slight increase at first and then an exponential increase to a small plateau between 1992 and 1993 hence gaining full credit. A few vague descriptions were seen which were less creditworthy. Candidates should be advised to include units and avoid 'unlinked' numbers in data quotes.

(ii) There was much confusion between artificial insemination and IVF. Strong candidates recognised that the fertility drug should be taken when the follicles are developing, but a number of candidates suggested taking the drug for five days with no mention of the stage of the reproductive cycle when this would be appropriate.

Question 6

(a) (i) Almost all candidates appeared to be familiar with the term producer, but many described its role in a food chain rather than the meaning of the term and thus did not gain credit. Stronger candidates knew that a producer makes its own food using energy from the sun. Very few used the term autotroph in their descriptions. There was a common misconception amongst many candidates that plants 'produce energy'.

(ii) Most candidates drew a correct food web. Some omitted the arrow heads or showed arrows going in the wrong direction. Almost all recognised that elephant grass was another producer. A minority added organisms to the food chain that were not in the text thereby not gaining full credit.

(b) Only the most able candidates described what happens to energy that is not passed from producers (vegetables) to primary consumers (humans). Most candidates seemed to be familiar with energy flow as a concept, but often gave processes by which animals might lose energy, such as movement and egestion rather than considering the reasons for energy loss at the first step in the food chain. Other common errors referred to loss of energy through 'photosynthesis' or 'into the soil'.

(c) Many candidates recognised that fish provide another possible source of income for the famer and that the fish could feed on waste materials, elephant grass cuttings and phytoplankton. A number mentioned the reduced risk of eutrophication. This question showed some insightful thinking on an unfamiliar context with many achieving full credit.

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BIOLOGY

Paper 0610/04
Coursework

General Comments

The majority of Centres that entered candidates for this component have done so for several years, and have gradually built up highly suitable sets of tasks, together with well-constructed mark schemes that enable appropriate and reliable assessment. There were examples of excellent work from many candidates, demonstrating high levels of achievement in even the more difficult skill areas such as evaluation and planning.

The chosen tasks covered a wide range. Several Centres used only four tasks; although this does allow each skill to be assessed at least twice, it very often leads to candidates having to use every one of their scores towards their final mark, with no possibility of discarding any scores. On the other hand, having more than 20 assessed tasks may be excessive. This is most likely to happen when there are several different sets of candidates assessed by different teachers, who choose to use different tasks. Most Centres have moved away from this arrangement, as it can be difficult to ensure comparable assessment for each candidate.

Not all Centres provided evidence for their assessment of C1. These tasks do not provide written evidence from the candidates, and so the assessors need to provide such evidence that can be seen by the external moderators. Most Centres provide tick lists to show how each candidate has met the criteria used during the assessment task.

On the whole, graphing skills were very good. Where candidates have the opportunity to use software for this, it is very important that they select the detailed format of the graph, rather than using the program default formats.

Not all Centres presented work that included comments from the teacher. It is important that the moderators are able to see fully marked work, which can help to explain why a particular mark was awarded.

There was a considerable amount of excellent work among the samples from many Centres. Some candidates demonstrated high levels of skill in the more demanding aspects of experimental work, such as planning and evaluating experiments, and discussing sources of experimental error.

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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.
- 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.
- need to show all stages in a calculation.
- need to understand how results are collected and measured, so that sources of error can be recognised and ways of improving an experiment can be suggested.
- should understand the difference between a control experiment and a controlled variable.
- measurements must use SI units as specified in the syllabus.
- should construct tables which have column headings that include the units and sufficient rows to show the results clearly.

General Comments

A greater mark range was seen this year than in previous years.

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 on 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

Half of a citrus fruit was provided for each candidate to draw before carrying out a practical task to find the effect of pH on the activity of an enzyme, pectinase, on the production of fruit juice from crushed fruit.

(a) Many good drawings of the cut surface of the citrus fruit were seen which had a clear outline, well-proportioned segments, and was labelled. Most candidates were able to draw the layers and segments of the fruit with a clear unbroken line using a sharp pencil. The regular outer shape was shown but a few candidates incorrectly used concentric rings as though a compass had been used. Use of a sharpened HB pencil is essential because if an ink pen is used instead of a pencil then it is impossible to erase errors so the final version is unlikely to gain much credit. The detail of the layers needs to be shown without any shading but to still be clear. A few drawings included immense fine detail of the juicy follicles in the flesh, these were not required. Most drawings were larger than the size of the specimen provided, as indicated by the details in the Supervisor's Report. A label line must make contact with the structure intended without a gap or an arrow head.

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(b)(i)&(ii) Candidates gave a range of acceptable colours with subsequent readings of pH, but there were a number who recorded grey or black. The Centre's Supervisor Report was invaluable to check with those recorded by the candidates. To record 'no change' was not acceptable as a definite colour was required.

(c) Most candidates placed the units correctly into the column heading in **Table 1.2** but some only recorded these with each of the individual volumes in the table, which is not creditworthy. Some inaccurate units were recorded such as ml^3 or cm^2. Most candidates recorded four volumes although considerable variation was often noted between the individual volumes recorded by the candidates compared to those by the Centre's Supervisor.

(d)(i)&(ii) Many candidates followed the instruction correctly but many did not appreciate what was required. It was common for the two volumes to be re-stated from **Table 1.2** without giving the difference in words or quantity that was required for a comparative statement. Often the appearance of the juice was omitted or a comparison between the appearance of the crushed fruit and the juice was given. Credit was awarded based on the individual candidates' results

(e) Stronger candidates compared the volumes and appearance of the samples **B2** and **D2** correctly and concluded the pH which favoured the enzyme activity from their results. There were many different interpretations of the question based on expressing the contrast between the two pH values with the volume of juice that was measured. The term 'optimum' with reference to the enzyme activity is not correct here as there was insufficient data to arrive at such a conclusion. Similarly the idea of the enzyme becoming denatured cannot be supported. The description comparing the effect of pH on the appearance of the juice was often omitted.

(f) (i) Many candidates knew that water was added for comparison or to act as a control for this investigation. Common errors based on dilution or neutralisation of the fruit juice indicated that candidates were confused possibly because buffer solutions were used. The purpose of a control experiment should not be confused with the controlled variables required in the following question..

(ii) Many candidates were able to state one correct controlled variable but only the stronger candidates gave two; volume of crushed fruit was the most common. Some candidates gave 'amount of juice' but this was the dependent variable to be measured. Other variables such as time, volume of enzyme or buffer were quite common.

(iii) Modifications to the investigation proved challenging. Some candidates chose repetition but in order to be creditworthy it needed to be qualified, for example to eliminate anomalies or for reliability. Candidates who changed the investigation rather than modifying it such as by using a different source of crushed fruit did not gain credit. Human error such as not reading the volume correctly or involving a second person were also not creditworthy. A number of candidates omitted this question.

Question 2

This second question was based on identifying where to record a pulse, comparing features of sections through blood vessels, calculating dimensions of a vein and planning an investigation into heart rate and exercise.

(a) (i) Most candidates indicated on the outline of the human body where a pulse can be felt. The method of indication, however, was not always clear, for example guide lines failing to make contact with the area or using only small dots. Accurate location was aided by the use of labelled lines.

(ii) Many candidates appreciated that the feature for these sites for the measurement of pulse is blood supply near to the skin surface or a hard bone to press against. However, many candidates only mentioned arteries or gave arteries instead of veins.

(b)(i)–(ii) Most candidates accurately measured the length of the line **XY** to the nearest millimetre and used the given formula but many did not give the actual diameter to one decimal place as stated in the question and some did not measure in mm.

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(iii) Candidates found this question very difficult and many omitted it. The vein was not quite circular and most candidates did not appreciate that if they were to measure the diameter in different positions around the structure the average would likely be more accurate.

(iv) To name three observed features between the vein and the artery shown in **Fig. 2.2** proved difficult for many candidates. As well as the confusion over diameter and length for the lumen, many answers included features that were not visible such as valves or types of blood. At this magnification it was not possible to recognise the tissue differences between the layers only that there were two types of layer present in the artery wall, indicated by the shading. Candidates were given credit for identifying differences even when the name of their feature was not accurate.

(c) (i) It was evident that quite a number of candidates are familiar with planning investigations and they gave good, well organised answers taking into account the necessary control variables. Reliability of results was taken into account with groups of students suggested or repeats if there was only one of each student type. Most candidates realised the importance of taking the pulse rate before and after the exercise. However, only a few candidates included the importance of the pulse rate being taken immediately after the exercise finished. A small number of candidates used heart monitors to record the pulse rate. Some candidates restricted their answers to a description for the effect of exercise and the outcome. A number of candidates misunderstood the requirement and compared two groups of participating students, the ones who were not used to taking regular exercise and did not take part in a common exercise regime. Some candidates extended their investigation to include monitoring the heart beat until it gets back to normal, this was not part of the question and so was not creditworthy.

(ii) Generally this was not well answered**.** Some candidates gave a well presented table with ruled lines, headings and sufficient rows for planned results but did not include units (beats per minute or bpm) in the column headings.

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BIOLOGY

Paper 0610/52
Practical Test

Key Messages

It is essential for this paper that candidates have experience of carrying out and collecting data from practical activities. They should be confident is using laboratory equipment and understand its limitations. Practice in recording, processing and interpreting data is also necessary to achieve a high standard.

Better performing candidates:

- know which SI units to use for measurements, in particular time, and record results using the correct abbreviations;
- construct tables that have headings that include the units and show results clearly;
- recognise sources of error in an experiment and know how to make improvements;
- understand the difference between a control experiment and a controlled variable.

General Comments

There were many examples of answers that were well written and showed a clear understanding of the question. These candidates were able to make reasoned explanations of results and draw conclusions.

Well prepared candidates were able to construct tables that had clear headings with units and allowed for replicate results to be shown as subsets of a single heading. Candidates who performed less well often put headings outside the table, with units in the body of the table. Many candidates recorded time in minutes and seconds, or in some cases included hundredths of a second. For results obtained using a timer, candidates should be encouraged to record time to the nearest whole second.

Candidates should be aware of the difference in presentation of a bar chart and a histogram. In this paper candidates were required to draw a bar chart, so the individual bars should be of equal width, separated from each other by the same distance and labelled centrally under each bar. Better performing candidates used suitable scales that could be plotted accurately; candidates who performed less well used scales that were too small or were uneven on the y axis, for example, 10 mm = 50 units at the first interval and then changing to 10 mm = 40 units.

There were some good examples of drawings, made with a sharp pencil and occupying over half of the space provided. Better drawings showed correct proportions and good observation of the shape of the chromosomes. Poorer drawings were often too small, shaded and drawn with little attention to the proportions of the cell.

The Supervisor's report is very important, particularly when materials have to be substituted from 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 if any 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.

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Comments on Specific Questions

Question 1

This question was a practical activity that involved cutting leaves to specific sizes and observing the reaction between catalase in the leaves and hydrogen peroxide. The practical skills tested were observation, accurate measurement using SI units, preparation of a table and recording results, interpreting results, recognising experimental variables, identifying sources of error and suggesting improvements, plotting a bar chart and drawing conclusions.

(a) (i) Better performing candidates showed a table consisting of a main heading for the independent variable with two main columns or rows for the different leaf sizes and subheadings for the replicates. These candidates also gave a suitable table heading for the independent variable, commonly leaf size or area with appropriate units. The majority of candidates gave time in seconds (s) for the dependent variable. Candidates who performed less well, either put the unit in the body of the table, omitted the units altogether or, in some cases, did not include a heading for time. Almost all candidates achieved results that showed a trend, commonly with the smaller 10 x 10 mm leaf piece rising more slowly. Only some candidates recorded the results in whole seconds. Candidates using sport stop watches often included hundredths and thousandths of a second as well, leading to errors in calculations of the mean. Similarly candidates who recorded in minutes and seconds also made errors in calculations, as they treated seconds as decimals instead of sixtieths of a minute. As already noted, candidates should record time to the nearest whole second and if calculating means or rates should work in seconds or whole minutes as appropriate.

(ii) Many candidates calculated a correct mean. Incorrect values were usually the result of errors using combinations of minutes and seconds or subdivisions of seconds. A few candidates only recorded one set of results in their table, which was stated to be the mean, but this meant there was no evidence that three sets of times had been recorded.

(iii) Almost all candidates gave a correct answer.

(b) (i) There were some excellent and well observed descriptions of the appearance and movement of the leaf pieces. Most candidates observed the presence of bubbles, although only better performing candidates noted that these came from the cut edges of the leaf and varied in size. These candidates also described the way in which the leaf moved to the surface. Other candidates rarely mentioned anything other than the formation of bubbles.

(ii) The majority of candidates were able to use the information given and their observations to describe the effect of catalase on the breakdown of hydrogen peroxide to releases oxygen. Better performing candidates also referred to the oxygen bubbles on the leaf surface reducing its density and allowing the leaf to float. Other candidates either omitted to mention catalase or stated that the bubbles were air being forced out of the stomata by hydrogen peroxide entering the leaf. A small number of candidates misunderstood the information and stated that oxygen was produced by photosynthesis.

(c) Only better answers showed an understanding that the source of catalase was the damaged cells at the cut edges of the leaves, so that the more cut perimeter, the greater the exposure of the enzyme to hydrogen peroxide. The majority of candidates stated that the increased surface area would cause an increase in the rate of reaction between catalase and hydrogen peroxide so that the leaf would rise more quickly. Better answers related an increase in catalase to an increase in oxygen production, resulting in the leaf piece lifting faster. Poorer answers often stated that the rate of reaction would increase, but did not show the understanding that there would be more catalase and more oxygen released. A few candidates realised that a bigger leaf piece would be heavier and slower to rise, but did not always explain why in terms of oxygen production.

(d) (i) Most candidates gave a correct answer, usually the volume or concentration of hydrogen peroxide, or the species of leaf. The most common incorrect answers were the size of the leaf, time and temperature.

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(ii) Very few candidates were able to give precise answers to this question. When assessing sources of error, candidates need to think about the variables in the experiment that must be standardised and the way in which the results are obtained. For example, in this experiment, cutting the leaf pieces accurately is quite difficult and so is timing three leaves at the same time. Improvements should then describe how to obtain accurate leaf pieces by using a cutter with a fixed size or cutting around a template. The improvement needs to be appropriate to the experimental set up, so suggestions such as 'use a digital stop watch instead of a mechanical stop clock' for greater accuracy does not improve the problem of trying to time three leaves at the same time. The suggested improvements such as counting the bubbles or collecting the gas are changing the way in which the results are collected, rather than improving the existing method. A common misconception was that removing the metal sinker would give better results, suggesting that these candidates did not understand the basis of the experiment.

(iii) There was a lot of confusion between a control for an experiment and controlled variables. Better performing candidates showed the understanding that a control should not include the independent variable, in this case catalase, but all other aspects of the experiment should be the same. The best answers substituted fresh leaf pieces for boiled leaf pieces or paper cut to the same size. Replacing the enzyme substrate, hydrogen peroxide, by water was also an alternative control. Candidates who performed less well identified what needed to be changed, but did not make it clear that the rest of the experimental procedure would be unchanged.
Many candidates only described how variables had been standardised, such as the volume of peroxide or stated that the experiment needed to be repeated any times to give a reliable result.

(e) (i) The majority of candidates answered this question well. The most common error was to omit a gap between the bars of the graph. Other candidates also missed out the units from the *y*-axis or mislabelled the individual bars on the *x*-axis. There were relatively few examples of careless plotting.

(ii) Better performing candidates were able to sequence the times for the different leaves and relate these to the activity or quantity of catalase in different species of leaves. Other candidates tended to identify the fastest and slowest leaf, without any explanation related to catalase. There were also candidates who had not read the question carefully and answered in terms of leaf surface area.

Question 2

This question tested the practical skills of observing, drawing and calculating size of cells from a magnified photograph.

(a) (i) The majority of candidates gave an answer within the accepted range, which took into account cells that were almost entirely within the boundary of the photograph. The most common error, which gave answers of 60–65 cells, was to include cells that were less than three-quarters within the boundary. Some candidates gave answers of 25–30 cells and appeared to have excluded the cells in various stages of mitosis.

(ii) A few candidates did not appear to read the question carefully enough and used a different number for the cells undergoing mitosis. In some cases the percentage was not rounded to the nearest whole number.

(b) Better performing candidates were able to identify the appearance of chromosomes in cell **B** and the presence of a nucleus in cell **A**. In some cases the nucleus was described as small dark circle, suggesting some confusion between the appearance of a nucleus and a nucleolus. Other candidates answered in terms of cell division, for example, cell **B** is dividing, cell **A** is not. There were many candidates who did not appear to be familiar with the appearance of cells in mitosis or that of chromosomes, so answers such as 'squiggles, 'stringy things' in cell **B** were common. There were also candidates who appeared to misread the question as they compared cell **A** and cell **C** or cell **B** and cell **C**.

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(c) (i) Overall there were relatively few drawings that met all of the expected criteria. Better performing candidates had a clear outline drawn with a sharp pencil without any gaps or shading and occupying at least half of the space available. These answers also showed that the cell in correct proportion with a cell wall. These candidates also showed the arrangement of the two sets of chromosomes in relation to the whole cell. Other responses suffered from poorly drawn outlines, sometimes in ink, with shading on the chromosomes and the cell wall omitted. Almost all candidates were able to label a chromosome, although some did not always have a labelling line touching a chromosome. Candidates should be encouraged to draw using a sharp pencil and pay attention to the relative proportion of different parts of a specimen. Labelling lines should be in pencil, drawn with a ruler and touch the feature being identified. It is not necessary to draw arrow heads on labelling lines.

(ii) Some candidates did not follow the instruction on the paper to draw a line along the length of cell C. A range of distances were accepted to take into account the indistinct cell wall at the ends of the cell. Candidates should be encouraged to record short lengths in mm, rather than in cm and mm, particularly if the measurement is to be used in a calculation of magnification or size of a specimen.

(iii) The majority of candidates were able to use their measurement to give an acceptable answer. Most errors arose from using measurements in cm to calculate the actual length. Candidates who used standard form made factor of 10 errors and gave answers such as 4×10^{-3} rather than 4×10^{-2}. Candidates need to be encouraged to think about the values they obtain for measurements and their feasibility. For example in this question, some of the answers obtained by incorrect calculations were several hundred mm long.

(d) Very few candidates gave correct answers to this part of the question, which required careful observation of the arrangement and appearance of the cells in the two areas. Candidates were not expected to be familiar with the detailed structure of the layers of a bronchus or a cancer tumour. Better performing candidates usually made a correct statement about the presence of layers in region **X**, the presence of different types of cell in region **X** or same type of cell in region **Y**, or the presence of very large nuclei in the cells of region **Y**. Only a few candidates gave two different features and very few noticed the invasive region of area **Y** extending into area **X**. The majority of answers were vague, for example that the cells look different in the two regions, or referred to features that could not been seen by observation, for example that there are more cells in region **Y** than in region **X** and that the cells in region **Y** were bigger than those in region **X**. Candidates who performed less well appeared to have ignored the information that the photograph was the wall of a bronchus and described features such as tar coating the lungs and mucus building up in the alveoli. Other candidates provided descriptions of light and dark cells.

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BIOLOGY (US)

Paper 0438/53
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 achieve high marks candidates

- are advised to pay particular attention to careful reading of the questions to plan the available time before starting to answer.
- need to be able to construct a results table, using ruled lines to include columns with appropriate headings and sufficient rows to show all results clearly.
- should understand how results are collected and measured, so that sources of error can be recognised and ways of improving an experiment can be suggested.
- should label graph axes clearly with the variable being plotted including the units, and use scales that occupy at least half of the grid.
- 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.
- should show all stages in a calculation. Measurements must use SI units as specified in the syllabus.
- should be familiar with variables that are to be changed, to be measured and to be controlled.

General Comments

Many candidates gave clear well presented answers.

Some candidates drew clear results tables but many did not and some drew two separate tables for the food tests results in **1(b)(i)**.

Graphs should be plotted so that most of the grid area is used, candidates should look carefully at the data so they can choose a scale that fits the available space. The scales should also be linear and easy to use when plotting the points. Plotted points need to small and accurately placed at the plot point. The correct choice of graph to represent the data accurately is important, **1(e)(i)** required a line graph.

Drawings of a half flower needed to be accurate, sufficiently large to occupy at least half of the space available with the correct number and proportion of floral parts and labelled with lines that made contact with the intended structure.

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 the practical materials specified in the Confidential Instructions some time in advance of the actual examination. This means that if difficulties arise there is time 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 Supervisors Report should include as much detail as possible to allow examiners to assess the candidate's answers appropriately.

Comments on Specific Questions

Question 1

This question was based on artificial urine samples for analysis following two common food tests for

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candidates to follow the instructions given for proteins using biuret and for reducing sugar using Benedict's solution. A planned results table had to be constructed to record observations of these food tests. Making the link between the recorded observations and the scenarios presented candidates were expected to make and explain a conclusion about the health of the person whose urine sample had been tested.

Candidates needed to understand how results are collected and measured, so that sources of error can be recognised and ways of improving an experiment might be suggested. Following a given set of data comparing glucose content of blood with that of excreted glucose in urine, a graph and data handling followed.

(a) Most candidates recorded correctly in **Table 1.1** that sample **C** appeared cloudy; and samples **A** and **B** clear yellow.

(b)(i)&(ii) Based on the information given many candidates constructed a single results table with ruled rows and columns to record their observations obtained after testing each of the samples in turn for the presence of reducing sugars and proteins. A few candidates presented two separate tables, one for each food test. Some drew boxes to record the final colours though many included extra details for the initial colour before testing. Many candidates completed the tests correctly.

(c) Given the scenarios for alternative health problems coupled with their food test results, many candidates could deduce and explain the three possible health diagnoses for the three people who had given 'urine' samples. However, many candidates found these links difficult. Where the final colours were different from those expected links could sometimes not be made.

(d) Very few candidates were able to give precise answers to this question. When assessing sources of error, candidates need to think about the variable in the experiment that must be standardised and the way in which the results are obtained. The improvement must cover details to explain how the error can be overcome. The error of differing water temperature was sometimes given but often not accompanied by how this might be improved such as using a thermostatically controlled water bath. Repetition was also given but again not accompanied by the reason. A few candidates indicated the difficulty of seeing the final colours and knew that the use of a colour chart would help.

(e)(i) The graph needed was a line graph and candidates found it challenging. The independent variable should be plotted on the horizontal axis (x-axis) which is the first column in **Table 1.2.** The dependent variable should be plotted on the vertical axis (y-axis) which is the second column in **Table 1.2**. The axes needed to be labelled to show the full title of each variable as given in the column headings of **Table 1.2b** and also the units. The scale for the axes needed to permit more than half of the printed grid to be used. The plotting of each point should be made by using a neat accurately positioned cross with a well-constructed ruled line between the plotted points or a smooth line not extending beyond the points. Candidates are advised not to use a large circular dot for plotted points as this fills a small square and creates difficulties when ruling the line between points. The correct choice of graph to represent the data accurately is important, a histogram or bar chart is not a suitable means to display this data.

(ii) Most candidates accurately described the trend as a positive correlation and also noticed that no glucose was excreted in the urine until after 200 mg per 100 cm^3 in the blood had been measured.

(iii) Most candidates managed to record correctly the mg per minute of glucose excreted in the urine when the blood glucose level reached 280 mg per 100 cm^3. Where the graph was presented correctly this involved a straightforward reading from the curve.

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Question 2.

(a) Details of the half flower provided by Centres were recorded in the Supervisor's Report. This is important to compare with the candidates' drawings.
Overall drawings of the half flowers were large, showing a well-proportioned image and labelled. The most common labelling error had the guidelines from the name not making contact with the intended part of the flower. Some candidates drew two flowers but a single drawing was required showing both the male and the female parts. Some candidates presented drawings of any flower but it was important that the drawing should resemble the flower that was supplied by the Centre. Use of a sharpened HB pencil was essential because if an ink pen is used it is impossible to erase errors so it becomes very difficult to award credit to the final version. The details of the numerous parts needed to be shown without any shading.

(b)(i)&(ii) Many candidates based the similarity and difference on the petal arrangement of the half flower shown in **Fig. 2.1**, however the part of the flower shown in **Fig.2.1** was the male flower and lacked any female parts.

(c) Most candidates accurately measured the length of the line **DE** on **Fig.2.1** to the nearest millimetre and applied the formula to determine the actual length given the magnification × 0.4 which was printed at the right hand side of **Fig. 2.1**.

(d)(i) Most candidates identified the independent variable correctly as the concentration of sugar solution.

(ii) Many candidates identified the dependent variable to be the growth of the pollen tube but this was not creditworthy as it does not take into consideration the time factor. It is the rate of growth of the pollen tube.

(iii) Many candidates gave one correct controlled variable but stronger candidates gave two.

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BIOLOGY

Paper 0610/61
Alternative to Practical

Key Message

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

Candidates need to check exactly what a question is asking for, e.g. questions starting with 'describe' and 'compare' need to be answered in different ways. In this paper, simply stating the different volumes produced in two measuring cylinders was not enough for a comparison.

Many candidates did not give an answer to one decimal place when asked. They should also know which SI units are required and use their correct abbreviations.

It is important that candidates use a sharp HB pencil and eraser for drawings. Drawings should be drawn with clear, continuous lines and have no shading. The guide line for a label must make contact with the structure intended and there should be no gap. To correctly calculate the actual length from a magnified photograph requires accurate measurements.

When constructing a table, candidates should use ruled lines to make columns and rows. The headings with correct units should accurately reflect the results to be displayed in the table. There were many tables drawn with no units in the headings and some tables had given examples of results with their units within the cells.

Comments on Specific Questions

Question 1

(a) Overall the standard of drawings was satisfactory for this paper and there were many good drawings. A small number drew a view of an orange segment from memory not from the photograph.

Many lines were needed to fully represent the internal structure, some of these were indistinct in the photograph. The outer surface of the fruit was clear and should have been drawn with a single, clear unbroken line without overlap. The outline should be drawn freehand and a common error was that candidates used a compass to give an unrealistic, perfect circle. Although there were many very clear, well drawn outline diagrams, a number of candidates tried to give too much detail, which was inaccurate. Only a small number of candidates represented different areas incorrectly with shading and random lines.

Most drawings were larger than the photograph. An ideal size would be to use most of the space provided.

Most candidates correctly drew a separate outer layer with a central area and three or more segments. The most common error was to draw the lines from the segments into the middle without leaving a clear central area. Some candidates did not show any segments.

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Most candidates correctly labelled the drawing. The most common correct label was the skin or peel. There were many irrelevant labels. The most common errors were xylem, phloem, cell wall and cell membrane. Most candidates drew label lines correctly. A small number of candidates did not label the diagram at all.

(b) Most candidates correctly matched the pH for buffers X and Y. The most common error was to convert their answer to acidic or alkaline rather than give the pH which was asked for.

(c) This was well answered. Most candidates correctly gave answers saying they were controls or for comparison. A small number correctly stated that it was to keep the initial volume the same. The most common errors were that the water would neutralise the solution or dilute the juice.

(d) The majority of candidates read the volumes correctly. However, many candidates incorrectly wrote the volumes and units within the table instead of putting the units in the heading.

(e) (i) This was well answered. The most common error for the volumes was to simply state the different volumes without making any comparison. The most common errors were different concentrations or colour which could not be identified.

(ii) The comparison for **C** and **D** was answered well. Most candidates correctly realised that the volumes and the appearance were the same for both. A common error was to say that the volumes were the same and then to give an incorrect volume.

(f) Better performing candidates were able to give clear, succinct answers. Candidates who performed less well made comparisons of **B** and **D** without any reference to the buffers, pH or acidity and alkalinity. Some candidates correctly linked the change in pH to the volumes and appearance of **B** and **D** but did not mention enzymes.

There were many incorrect references to pH 4 being the optimum pH and enzymes being denatured a pH 8. Although there was evidence that the enzyme worked better in pH 4, there is no way of knowing whether or not this was the optimum pH. Furthermore, there was no evidence that the enzyme was denatured at pH 8. There were a significant number of candidates that did not know that acid had a low pH and alkalis had a high pH.

(g) (i) This was not well answered. Many candidates did not refer back to the information given. The most common errors were referring to same volume of juice rather than volume of crushed fruit or saying that the volumes of enzyme and / or water were kept the same. There were many vague references to temperature and time.

(ii) This was not well answered. Many candidates simply suggested 'repeats for accuracy' (which is in the question) or 'repeats' without any explanation. Candidates need to be aware that controlling the temperature is not the same as keeping the temperature constant. Candidates who performed less well gave incorrect suggestions that would change the experiment completely, for example using different fruits.

Question 2

(a) (i) This was well answered, the majority of candidates correctly identified two pulse sites, most commonly the wrist and the neck. The most common error was to indicate the heart. Some candidates used label lines that did not touch the site they were trying to indicate.

(ii) This was not well answered. Many candidates had the correct idea about their position being near the surface of the skin but they referred to blood vessels or veins and did not specify an artery alone. Only a small number described arteries that could be pressed against a bone. A common error was to say that it was the place where arteries had more blood pressure.

(b) Most candidates were aware that, by taking the pulse rate, this would give an indication of the heart rate. Only the better performing candidates realised that they would need to press on the pulse site. Most candidates correctly counted the beats felt per unit time or per minute. A small number said that they would count the number of beats in a particular time and divide by the time. The most common error was to count or to calculate the beats per second. A small number of candidates tried, incorrectly, to feel the actual heartbeat.

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(c) (i) (ii) Most candidates accurately measured the line **XY.** A small number did not give their answer in mm as required. Many candidates calculated the diameter correctly but failed to give their answer to one decimal place.

(iii) Only the better performing candidates were able to suggest using diameters from different points around the vein and finding an average. Most candidates only tried to improve the accuracy of measuring the line **XY**. The most common errors were to repeat the measurement of **XY** and find an average, to use higher magnifications to get a more accurate measurement or try to use instruments such as Vernier calipers. Other candidates incorrectly suggested measuring more veins or measuring the blood flow. Quite a number of candidates measured the entire length of the vein. There were a small number of incorrect suggestions to measure the radius and use a formula to calculate the diameter.

(iv) Overall, this was not well answered. The most common error was to describe features that were not visible in the photograph e.g. valves, blood pressure, types of blood and various named tissues. Candidates referred to muscle or elastic tissue without actually identifying them. The term 'lumen' was quite well known. The difference in shape was rarely seen.

(d) (i) It was evident that quite a number of candidates were familiar with planning investigations. There were quite a number of good, organised answers taking into account the necessary control variables. Most realised the importance of taking the pulse rate before and after the exercise. However, only a few candidates realised the importance of the pulse rate being taken immediately after the exercise. A small number of candidates used heart monitors to record the pulse rate.

Some candidates extended their investigation to include monitoring the heart beat until it gets back to normal. This was not necessary. A small number of candidates incorrectly investigated the difference in heart rate between candidates exercising and not exercising. Candidates who performed less well did not give details of any experiment but simply described expected results.

(ii) This was not well answered. Although the layout and content of many of the tables were correct, the presentation was very poor. Many candidates gave incomplete headings and did not include units. A small number of candidates gave examples of possible results and incorrectly put their units within the table.

Most candidates did include the type of candidate in their heading. Some headings showed timings for the results of heart rate taken throughout the exercise period but did not make a clear row or column for the heart rate taken after completion of the exercise.

Quite a number of better performing candidates showed the difference in heart rate before and after exercise and / or the average heart rates for more than one candidate in their tables.

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BIOLOGY

Paper 0610/62
Alternative to Practical

Key Messages

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

To achieve high marks, candidates should:

- read questions carefully before starting to answer.
- know which SI units to use for measurements, in particular time and distance and the correct abbreviations.
- construct ruled tables that have headings that include the units and show results clearly.
- show all stages in a calculation.
- understand the difference between a control experiment and a controlled variable.

General Comments

There were many examples of answers that were well written and showed a clear understanding of the question. These candidates were able to make reasoned explanations of results and draw conclusions. Stronger candidates were able to construct tables that were drawn carefully with a ruler and with clear headings with units that allowed for replicated results to be shown as subsets of a single heading. Weaker candidates answers often put headings outside the table with units often in the body of the table. The most common error was failure to convert the times from **Fig 1.3** into seconds. There was generally a poor understanding of what time values the stop clock figures actually represented. Candidates should be encouraged to use seconds to record time.

Graphs should be plotted so that most of the grid area is used, candidates should look carefully at the data so they can choose a scale that fits the available space. **1(e)(i)** required candidates to draw a bar chart. Candidates should be aware of the difference in presentation of a bar chart and a histogram. For a bar chart the individual bars should be of equal width, separated from each other by the same distance and labelled centrally under each bar. Stronger candidates used suitable scales that could be plotted accurately, weaker candidates used scales on the y-axis that were either too small or were non-linear.

There were some good examples of drawings, carefully drawn with a sharp pencil and occupying over half the space provided. Better drawings showed correct proportions and good observation of the shape of the chromosomes. Weaker drawings were often too small, barely larger than the photograph, shaded and drawn with little attention to detail of the proportions of the cell.

Comments on Specific Questions

Question 1

The candidates were presented with an investigation into the activity of catalase found in leaves and hydrogen peroxide solution, in which two different sized pieces of leaf were placed in the solution and the time taken to rise was recorded. They were given the times recorded on the timers and an account of a student's observations of the pieces of leaf.

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The practical skills tested were: preparation of a table from the data presented for leaves of different sizes, 10 × 10 mm leaf pieces and 15 × 15 mm leaf pieces and the time taken for each set to rise; recording the results; calculating the mean time for each size of leaf to reach the surface; interpreting results and making predictions; recognising experimental variables; identifying sources of error and suggesting improvements; plotting a bar chart and drawing conclusions.

(a) (i) Most candidates gave a table with ruled rows and columns. Sometimes there was no outer ruled frame to the section but this was acceptable. Most included the data into a single table as expected. Stronger candidates drew a table consisting of a main heading for the independent variable with two main columns or rows for the different leaf sizes and subheadings for the replicates. These candidates also gave a suitable table heading for the independent variable, commonly leaf size or leaf area, with appropriate units. These candidates gave time in seconds (s) for the dependent variable. Weaker candidates either put the units into the body of the table, omitted the units altogether, or in some cases did not include the heading for time. The most common error was a failure to convert the times from **Fig 1.3** into seconds. For these candidates there was little understanding of what time values the stop clock figures actually represented. A few candidates converted the times into decimals of minutes.

(ii) Whilst many candidates could correctly calculate a mean, many failed to convert the answer to seconds or to minutes and seconds using the same format as on the stop clock. Minutes and seconds were used interchangeably and inappropriately by many, a follow on from errors in tabulation in **1ai**.

(iii) Most candidates made the correct association between leaf size and the time taken for it to rise to the surface. It was expressed in a variety of ways but usually correctly.

(b) It was understood by most that an enzyme/catalase reaction was involved and the bubbles were the result of that action, but a significant number failed to name the bubbles as being oxygen bubbles. The connection that the bubbles were produced by the reaction and caused the leaf to rise or float was well expressed by many candidates. Stronger candidates also referred to the oxygen bubbles on the leaf surface reducing its density. Weaker candidates either omitted to mention catalase or stated that the bubbles were air being forced out of the stomata by hydrogen peroxide entering the leaf. A few candidates thought incorrectly that the oxygen was produced in photosynthesis.

(c) The majority of candidates predicted that the 20 mm × 20 mm leaf piece would rise faster than the smaller leaf pieces and a significant number even predicted the number of seconds this might take. Stronger candidates related an increase in catalase to an increase in oxygen production, resulting in the leaf piece lifting faster. Many answers gave their reasons to be due to increased surface area or just to the fact that the leaf pieces were larger. Rarely was a reference made to the cut edge and that the source of catalase was the damaged cells at the cut edge of the leaves so the more the cut perimeter, the greater the exposure of the enzyme to the hydrogen peroxide.

(d) (i) Most candidates gave a correct answer, usually the volume or concentration of hydrogen peroxide or the species of leaf. The most common incorrect answers were leaf size, temperature or time.

(ii) Very few candidates were able to give precise answers to this question. When assessing sources of error, candidates need to think about the variable that must be standardised in the experiment and the way in which the results are obtained. For example, cutting the leaf pieces accurately is quite difficult and so is timing three leaves at the same time. Improvements for leaf size could show using a cutter with a fixed size or cutting around a template would decrease the effect of the error. The improvement needs to be appropriate to the experimental set up, so a suggestion such as use a digital stop watch instead of a mechanical stop clock for greater accuracy does not improve the problem of trying to time three leaves at the same time. Time, which was the dependent variable, was a very common answer. Temperature was another common incorrect response. Suggested improvements such as counting the bubbles or collecting the gas are changing the way in which the results are collected, rather than improving the existing method. A common misconception was that removing the metal sinker would give better results, suggesting that these candidates did not understand the basis of the experiment.

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(iii) There was a lot of confusion between a control for an experiment and controlled variables. Stronger candidates showed the understanding that a control should not include the independent variable, in this case catalase, but all other aspects of the experiment should be the same. The best answers substituted fresh leaf pieces for boiled leaf pieces or paper cut to the same size. Replacing the enzyme substrate, hydrogen peroxide, by water was also an alternative control. Weaker candidates identified what needed to be changed, but did not make it clear that the rest of the experimental procedure would be unchanged.
Many candidates did not gain any credit as they described how variables had been standardised, such as the volume of peroxide or stated that the experiment needed to be repeated many times to give a reliable result. This was also the most common question that was left blank.

(iv) Most candidates gave hydrogen peroxide as the hazard and scored both marks if they went on to identify the nature of the hazard. Some just gave the correct precaution of using gloves and/or goggles without giving the hazard and some incorrectly considered that hydrogen peroxide was explosive and required the use of a fume cupboard. A few candidates referred to harm from cutting the leaves but these answers rarely gained credit as they did not usually include a suitable safety precaution such as cutting away from fingers or using a tile with the knife.

(e) (i) Many candidates gained maximum credit with their bar charts which were well executed in size and accuracy. The most common error was to omit a gap between the bars of the graph. Weaker candidates omitted the units from the y axis or mislabelled the individual bars on the x axis. There were relatively few examples of careless plotting. There were very few line graphs.

(ii) Stronger candidates gained maximum credit, as they were able to sequence the times for the different leaves and relate these to the activity or quantity of catalase in different species of leaves. Weaker candidates tended to identify the fastest and slowest leaf without any explanation related to catalase.
Some candidates were ambiguous in their descriptions so that it was unclear whether the speed being referred to was the speed of the leaf rising or the speed of the enzyme action. A few weaker candidates were confused and contradicted themselves when it came to describing the trend for all four species. A few candidates incorrectly answered in terms of surface area. Candidates would find it useful to reread their answers and check the data.

Question 2

This question tested the practical skills of observing, drawing and calculating size of cells from a magnified photograph.

(a) (i) The majority of candidates gave answers within the accepted range, which took into account cells that were almost entirely within the boundary of the photograph. The most common error, which gave answers of 60 – 65 cells, was to include cells that were less than three quarters within the boundary. Some weaker candidates, giving answers of 25 – 30, cells appeared to have excluded the cells in various stages of mitosis.

(ii) Most candidates were able to gain maximum credit for this question. A few candidates did not use the number of cells given in the question for their calculation. Some candidates having correctly converted the number of cells to a percentage then failed to convert to a whole number.

(b) Stronger candidates gained maximum credit as they were able to identify the appearance of chromosomes in cell **B** and the presence of a nucleus in cell **A**. In some cases the nucleus was described as a small dark circle, suggesting some confusion between the appearance of a nucleus and the nucleolus. Many candidates who were not familiar with the appearance of chromosomes or cells in mitosis so answers such as ‘squiggles’ and ‘stringy things’ in cell **B** were common and gained no credit. Some candidates compared cell **A** and cell **C** or cell **B** and cell **C** rather than cell **A** and cell **B**. Some candidates answered in terms of cell activity (dividing and not dividing) rather than observable differences between cells **A** and **B**.

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(c) (i) Overall there were relatively few drawings that met all of the expected criteria. Stronger drawings had a clear outline drawn with a sharp pencil without any gaps or shading and occupied at least half of the space available. These answers also showed the cell in correct proportion with a cell wall. The best drawings also showed the arrangement of the two sets of chromosomes in relation to the whole cell. Weaker drawings suffered from poorly drawn outlines, sometimes drawn in ink, with shading on the chromosomes, the cell wall omitted and drawings which were too small. A few candidates drew what looked like diagrams they had seen in textbooks, rather than attempting to interpret the given cell image. Almost all candidates were able to label a chromosome, although weaker candidates did not always have a labelling line touching a chromosome. Candidates should be encouraged to draw using a sharp pencil and pay attention to the relative proportion of different parts of a specimen. Labelling lines should be in pencil, drawn with a ruler and touch the feature being identified. Candidates that put an arrowhead on their label need to ensure that the head is connected to the shaft.

(ii) Good answers gained maximum credit. Some otherwise good answers did not gain maximum credit as the requested line along cell C was not drawn. Candidates who drew a line for the width of the cell were not credited. Some candidates measured correctly but did not draw a line on **Fig 2.2**. Some candidates incorrectly measured their drawings rather than the photograph. A range of distances was credited to take into account the indistinct cell wall at the ends of the cell. Candidates should be encouraged to record short lengths in mm, rather than in cm and mm, particularly if the measurement is to be used in a calculation of magnification or size of a specimen.

(iii) The majority of candidates were able to use their measurement to give an acceptable answer. Error carried forward was allowed for incorrect measurements of cell C. Answers that were presented in standard form or rounded to the nearest mm were all credited. Most errors arose from using a measurement in cm to calculate the actual length, for example dividing 3.5 cm by 800 gives an answer of 0.004 mm, which is incorrect, while dividing 35 mm by 800 gives an acceptable answer of 0.04 mm. Candidates who used standard form made similar errors and gave answers such as 4×10^{-3} rather than 4×10^{-2}. Candidates do need to be encouraged to check answers for plausibility, as some sizes obtained by errors such as multiplying by 800 rather than dividing were well into the visible range.

(d) Very few candidates gave correct answers to this part of the question, which required careful observation of the arrangement and appearance of the cells in the two areas of the photograph. Candidates were not expected to be familiar with the detailed structure of the layers of a bronchus or a cancer tumour. Stronger candidates usually made a correct statement about the presence of layers in region **X**, the presence of different types of cell in region **X** or same type of cell in region **Y**, or the presence of very large nuclei in the cells of region **Y**. Only the strongest candidates gave two different features. Very few candidates noticed the invasive region of area **Y** extending into area **X**. The majority of candidates gave vague responses such as the cells look different in the two regions, or they referred to features that could not been seen by observation, for example that there are more cells in region **Y** than in region **X** or that the cells in region **Y** were bigger than those in region **X**. Some weaker candidates ignored the information that the photograph was the wall of a bronchus and described features such as tar coating the lungs and mucus building up in the alveoli. Other weak answers described light and dark cells and even cilia. Candidates need to focus on what can be seen rather than responding with factual material which cannot be inferred from what is seen.

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BIOLOGY

Paper 0610/63
Alternative to Practical

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 achieve high marks candidates

- are advised to pay particular attention to careful reading of the questions to plan the available time before starting to answer.
- should label graph axes clearly with the variable being plotted, including the units and use scales that occupy at least half of the grid.
- 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 is that it must make contact with the structure intended without a gap or an arrow head.
- should show all stages in a calculation. Measurements must use SI units as specified in the syllabus.
- need to be familiar with variables that are to be changed, to be measured and to be controlled.

General Comments

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

Candidates must read the questions carefully such as in **1b** where links between observations from food tests and information in the question needed to be linked to arrive at a conclusion about three possible medical diagnoses.

Graphs should be plotted so that most of the grid area is used, candidates should look carefully at the data so they can choose a scale that fits the available space. Strong candidates used suitable scales that could be plotted accurately, weaker candidates used scales that were too small or were difficult to plot, or were non linear. Plotted points need to be small and accurately placed at the plot point. The correct choice of graph to represent the data accurately is important. In this paper candidates were required to construct a line graph.

Drawings of the side view of the flower needed to be made accurate, sufficiently large to occupy at least half of the space available with the correct number and proportion of floral parts and labelled with lines that made contact with the intended structure.

Some knowledge of the classification of animal groups was required but most of these questions were based on observational skills of the details shown in four illustrations.

Comments on Specific Questions

Question 1

This question was based on artificial urine samples for analysis following two common food tests for candidates. This was followed by making the links between observations for food test to arrive at a conclusion about the health of the three possible medical diagnoses. Candidates were expected to be familiar with testing the pH of solutions to be able to compare the suitability of using universal indicator paper or solution as opposed to litmus paper. Following a given set of data comparing glucose content of blood with that of excreted glucose in urine, a graph and data handling followed.

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(a) Most candidates were able to describe the method that could be used to test the three urine samples for reducing sugar and protein. It was important to include at least one safety factor such as the use of a water bath for heating the Benedict's solution with the sample for the reducing sugar test. The final colours were not required since these were given in **Table 1.1**.

(b) Given the scenarios for alternative health problems coupled with the food test observations given in **Table 1.1**, many candidates could deduce and explain the three possible health diagnoses for the three people who had given 'urine' samples. However, many candidates found these links difficult. Advice to visit your doctor was not an appropriate response

(c)(i)&(ii) Although many candidates did explain why the litmus test was not a suitable means to test the pH of an urine sample as it would only indicate if the solution was acid or alkaline, others were not familiar with the use of litmus. Use of Universal Indicator paper or solutions or a pH meter were commonly suggested, but not always.

(d) (i) The graph needed was a line graph and candidates found it challenging. The independent variable should be plotted on the horizontal axis (x-axis) which is the first column in **Table 1.2.** The dependent variable should be plotted on the vertical axis (y-axis) which is the second column in **Table 1.2**. The axes needed to be labelled to show the full title of each variable as given in the column headings of **Table 1.2b** and also the units. The scale for the axes needed to permit more than half of the printed grid to be used. The plotting of each point should be made by using a neat accurately positioned cross with a well-constructed ruled line between the plotted points or a smooth line not extending beyond the points. Candidates are advised not to use a large circular dot for plotted points as this fills a small square and creates difficulties when ruling the line between points. The correct choice of graph to represent the data accurately is important, a histogram or bar chart is not a suitable means to display this data.

(ii) Most candidates accurately described the trend as a positive correlation and also noticed that no glucose was excreted in the urine until after 200 mg per 100 cm^3 in the blood had been measured.

(iii) Most candidates managed to record the mg per minute of glucose excreted in the urine when the blood glucose level reached 280 mg per 100 cm^3 correctly. If the graph was presented correctly this involved a straightforward reading from the curve.

Question 2.

(a) Overall drawings of the half flowers were large, showing a well-proportioned image and labelled. Details of the flower were shown in **Fig. 2.1**, a whole lily flower showing the six petaloid parts with a leaf behind. It is important that candidates observe this image carefully so they can correctly base their drawings on it and display the correct number of floral structures. It is important that the drawing should resemble this flower that is shown and not any other stylised flower.
Use of a sharpened HB pencil is essential because if an ink pen is used instead then it is impossible to erase errors so it becomes difficult to give credit to the final version. The details of the numerous parts need to be shown without any shading. The most common labelling error, however, was that label lines did not make contact with the intended structure. It is important that the drawing does include the whole flower and that if any part is omitted it not acceptable. A single drawing is required in order to show both the male and visible female parts as resembling that seen in **Fig.2.1**, they should not be separated into two drawings.

(b)(i)&(ii) Many candidate based the similarity and difference of the flowers shown in **Fig 2.2** on the petal arrangement. Many candidates did not appreciate that the part of flower **B** shown was male and lacked any female parts.

(c) Most candidates accurately measured the length of the line **DE** on **Fig.2.1** to the nearest millimetre and applied the formula to determine the actual length given the magnification × 0.4 which was printed at the right hand side of **Fig. 2.1**. Candidates should use the appropriate SI units

(d) The three parts to this section were based on different types of variables.

(i) Most candidates identified the independent variable correctly as the concentration of sugar solution.

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(ii) Many candidates identified the dependent variable to be the growth of the pollen tube but this was not creditworthy as it does not take into consideration the time factor. It is the rate of growth of the pollen tube.

(iii) Many candidates gave one correct controlled variable but stronger candidates gave two.

Question 3

Based on four images of animals that pollinate flowers, candidates were to record differences and similarities based on visible, observable features.

(a) (i) Most candidates commented on the presence or absence of a feature such as feathers shown by animal **G**. Some candidates went on to classify these two animals by their naming their group such as a bird versus an insect, this was not required.

(ii) In the side view images of **H** and **J**, it was not possible to see all of the of the eyes, wings or legs, so these names alone were sufficient for candidates to gain credit.

(b) (i) The only two animals to belong to the same animal group were the two insects **H** and **J**.

(ii) Most candidates correctly named insects as the group and included a correct reason for their choice.

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