BIOLOGY

Paper 0970/11
Multiple Choice (Core)

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

General comments

There was a good understanding of the characteristics of arthropods, biological molecules, the structure of the breathing system in humans and characteristics of living organisms.

There was some uncertainty about the concentration gradient needed for fast diffusion into cells, which food test is used to test for protein and the structure of an insect-pollinated flower.

Candidates should be able to use descriptions of terms in the syllabus such as species, and excretion and recognise the word equations for respiration.

Candidates need to read the questions (for example **Question 30** and **Question 33**) and interpret diagrams carefully (such as in **Question 7 and Question 27**).

Comments on specific questions

Question 1

A small number of candidates were not aware that living organisms excrete carbon dioxide from their bodies, instead believing that it is removed by respiration.

Question 4

Most candidates were able to calculate the magnification of the animal.

Questions 13

Many candidates could correctly label the axes, but some mixed up the *x*-axis and the *y*-axis. Others incorrectly thought carbon dioxide is produced during photosynthesis.

Question 16

Only a minority of candidates could identify magnesium as the ion needed to make chlorophyll with a significant number choosing starch.

Question 17

Some candidates thought that the gall bladder produces bile, rather than storing bile.

Question 19

Some candidates could not use the information to identify food X as starch. A minority thought that food X was protein even though no chemical digestion of food X occurred in the stomach.

Question 23

Most candidates could identify the red blood cell as the cell that contained haemoglobin.

Question 29

Most candidates could identify the pancreas as the organ that secretes insulin, but the majority could not then identify its effect on blood glucose concentration.

Question 32

Although many candidates correctly selected the ovary, some candidates incorrectly identified the oviduct as the part of the female reproductive system that releases egg cells.

BIOLOGY

Paper 0970/12
Multiple Choice (Core)

There were too few candidates for a meaningful report to be produced.

BIOLOGY

Paper 0970/21
Multiple Choice (Extended)

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

General comments

There was a good understanding of the characteristics of living things, carbohydrate digestion, natural selection and reasons for species becoming endangered.

There was some uncertainty about the effects of immersion in different solutions on plant cells, digestive enzymes, the effect of cholera toxin and how to interpret pedigree diagrams.

Candidates need to read the questions (for example **Questions 9** and **15**) and interpret diagrams carefully (such as in **Questions 11, 12, 30** and **34**).

Comments on specific questions

Question 5

Most candidates were unable to describe the state of the plant cells after being immersed in solutions of different concentration.

Question 9

Most candidates could identify the conditions that led to fats being broken down most quickly, but a few did not realise that boiled lipase would be denatured and therefore inactive.

Question 12

A few candidates believed that the liver rather than the gall bladder stored bile.

Question 17

A few candidates did not know that high humidity reduces the transpiration rate**.**

Question 22

A small minority did not realise that an antibody molecule is complementary in shape to an antigen rather than having the same shape.

Question 23

Many candidates could not identify the function of cilia in the human gas exchange system.

Question 28

A small number of candidates incorrectly thought glucagon reduces blood glucose concentration.

Question 32

Some candidates incorrectly thought that stem cells were gametes.

Question 35

Many candidates were confused about the products and purpose of meiosis. Meiosis produces cells that are not genetically identical, and these cells are not involved in the repair of damaged tissues.

Question 38

Many candidates were unsure about the role of the different bacteria in the nitrogen cycle, in particular thinking that nitrogen-fixing bacteria remove nitrate from the soil.

Question 40

A few candidates thought that artificial selection is an example of genetic modification.

BIOLOGY

Paper 0970/22
Multiple Choice (Extended)

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

General comments

There was a good understanding of the characteristics of living organisms, base pairing in DNA and protein digestion.

There was some uncertainty about the circulation in fish, aerobic respiration, and variation.

Candidates should be able to use descriptions of terms in the syllabus such as turgid, flaccid and translocation.

Candidates need to read the questions (for example **Questions 20** and **32**) and interpret diagrams carefully (such as **Questions 14, 30** and **31**).

Comments on specific questions

Question 8

Many candidates were unaware that pH changes do not affect the kinetic energy of the particles.

Question 13

A few candidates incorrectly chose option **C**, although some water is reabsorbed in the large intestine, most water is reabsorbed in the small intestine.

Question 20

There was confusion about the action of cholera toxin on the body with a some describing it acting in the large intestine.

Question 22

Candidates should be able to recall the balanced chemical equations given in the syllabus. Some candidates did not realise that two molecules of glucose produce 12 molecules of water rather than 6.

Question 24

Some candidates thought that amino acids are deaminated and converted to urea in the kidneys instead of the liver. The kidneys are the site of urea excretion.

Question 30

Most candidates could interpret the diagram of the development of a pollen tube, but a significant number incorrectly believed that fertilisation had occurred even though the pollen tube has not reached the ovary.

Question 31

Many candidates did not interpret the diagram correctly and so did not realise that the umbilical vein transports blood from the placenta to the fetus.

Question 34

Many candidates could not correctly describe types of variation or their causes.

Question 40

A few candidates could not identify the first step in this process. The human DNA making up the gene must be isolated before it can be inserted into a plasmid.

BIOLOGY

Paper 0970/31
Theory (Core)

Key messages

Candidates should read the questions carefully, as they often contain specific information that must be used in the answer.

Command words such as 'describe', 'explain', 'suggest' and 'compare' require different responses from candidates. If a description is required, including a reference to a graph or table, then it will be expected that data will be used in the description given. Many candidates can do this effectively. An explanation requires more than just a description and candidates should be encouraged to practise the difference between 'explain' and 'describe'. Correct spelling of certain words is expected e.g., uterus, ureter, and urethra.

General comments

Many candidates were well prepared for the exam and had obviously referred to past papers and mark schemes when preparing. This type of preparation helps candidates to express themselves clearly.

Comments on specific questions

Question 1

(a) (i) Most candidates correctly named carbon dioxide although some gave oxygen.

(ii) This was generally well answered, with both (anaerobic) respiration and fermentation being creditworthy.

(b) A range of correct answers were seen, but some candidates gave insufficient detail with answers like fuel, rather than biofuel, or cleaning products without further qualification.

(c) Stronger candidates had no difficulty identifying the correct options. A lack of knowledge about bacteria was shown by some choosing incorrect statements, such as reproduce sexually, or have the same structures as plant cells.

(d) Most candidates drew on their recall of MRS GREN to give three correct answers. Movement was often incorrectly given for sensitivity. Occasionally, a candidate confused excretion and egestion, or growth and reproduction.

(e) Cell wall, cell membrane and cytoplasm were the most common correct responses. When vacuole was offered, it was not specific enough (it needed to be small or temporary). Quite a few responses incorrectly suggested that mitochondria or nuclei are found in bacteria.

Question 2

(a) Most candidates knew that catalysts speed up the rate of a reaction and are not changed by it. Many thought that catalysts were organisms or biological molecules such as proteins, obviously confusing them with enzymes. Candidates should understand the difference between catalysts and enzymes.

(b) Generally, well answered. Some incorrect answers included bacteria, fatty acids, and yeast.

(c) (i) Marks were usually gained for describing the general trends of the graph for enzymes **A** and **B**, the optimum temperatures for both enzymes and the temperatures at which they were denatured. Although the question instructed candidates to use data from the graph to support their answers, this was not always done, or the candidate omitted to give units with data they quoted. Sometimes marks were missed as the answer described features of the graph for one enzyme, rather than making a comparison. The reading of data from the graphs was often incorrect and so no data mark could be awarded.

(ii) Some candidates knew the term active site.

(iii) The most common correct answer was pH, though some gave the concentration of the product, substrate, or enzyme, which was also creditworthy.

(d) Many candidates gained all three marks. Those who did not thought that enzymes were hormones or were made only of carbon, hydrogen, and oxygen.

Question 3

(a) (i) Most candidates did the calculation correctly, although some did not express their answers to the nearest whole number. Errors included the use of all figures in row **C** rather than just trials 1, 2 and 3, and rounding down.

(ii) Candidates were able to express the correct trend in terms of an increase in surface area causing either an increase in the rate of diffusion or a decrease in the time taken for the blocks to turn yellow. Some candidates referred to increasing diffusion rather than increasing the rate or speed of diffusion.

(iii) The commonest correct response was to state that temperature could affect diffusion. Incorrect suggestions included volume of acid, number of agar blocks and surface area.

(iv) Candidates generally gained at least two marks on this question. The gradient was sometimes stated to be high or low, rather than a concentration gradient. However, some candidates incorrectly referred to heat, thermal, chemical or potential energy.

(b) Many candidates knew that osmosis was related to the movement of water, but fewer stated that it occurred through a partially permeable membrane. Stronger responses made both points. Some referred to water but did not make it clear that the water was moving. Weaker responses only described movement down a concentration or water potential gradient, without stating that it was water that was moving, or just described osmosis as the movement of liquids.

(c) (i) Many candidates correctly selected oxygen and glucose. The most frequent incorrect choices were carbon dioxide and water.

(ii) Several candidates recognised mitochondria as the correct site of aerobic respiration, but a significant number named a range of other cell structures, such as nucleus and membrane.

(iii) Most candidates correctly stated cell membrane as the answer. Cell wall was the most common error.

Question 4

(a) Two marks were available, but these were not gained by candidates who did not use the terms pathogen, bacteria, viruses, or microbes, instead using non-creditworthy terms like disease or germs. Sometimes only one mark was gained because the candidate focused on the handwashing aspect, omitting to state where the pathogens had come from.

(b) A considerable number of candidates thought, incorrectly, that filtering water is enough to prevent the spread of disease through it. Only microfiltration would do this. Marks tended to be gained for boiling water, chlorination, and sewage treatment.

(c) This was well answered, but some missed marks for giving three answers that were too similar, such as white blood cells, antibodies, and phagocytosis. Some candidates just stated the mechanisms as chemical, mechanical and cells, without giving examples.

(d) Generally, this was well answered, although some candidates thought that coronary heart disease and/or scurvy are transmissible.

Question 5

(a) (i) Some candidates did not realise that a comparison was needed between test-tubes with suitable conditions that included one with oxygen (**C**) and one without, and selected both **D** and **E**, rather than either **D** or **E**.

(ii) Most candidates selected the correct boxes. The most common error was to include low carbon dioxide or low pH as one of their choices.

(b) (i) Candidates who described plant **Y** often provided a suitable prediction in terms of upright growth with no bending. Stronger responses described how the light (entering from one direction) would reach all parts of the plant as it was turning. Weaker responses thought that the rotation would result in light from all directions, or that plant **Y** would grow faster or grow more.

(ii) Many candidates correctly stated phototropism but a minority incorrectly thought it was gravitropism. Some candidates wrote photosynthesis.

(iii) The question required candidates to identify and explain a possible advantage of tropic responses in shoots, but a significant number wrote about tropic responses in roots. Several candidates recognised that phototropism would be an advantage in terms of receiving light for photosynthesis, but only stronger responses gave the full explanation of gaining more light for more photosynthesis.

(c) Many candidates knew that plants are producers or occupy the first position in the food chain. Common incorrect answers included consumers, herbivores or carnivores.

Question 6

(a) (i) The most common correct responses were buildings, house construction or new roads. Some candidates misunderstood the question and wrote about consequences of deforestation rather than the reasons.

(ii) A few candidates were able to score full marks here. While many had the idea of producing lots of cabbages, they did not convey the idea of more cabbages. Some realised that the same fertiliser or pesticide was used, and that harvesting was easier. When writing about the economic side of monocultures, candidates wrote about making lots of money or profit instead of more.

(b) It was clear that candidates understood conservation, but some had difficulty clearly expressing their ideas. Many discussed breeding or giving them more food, but really were too vague to be awarded marks. The question had the phrase ‘other than protection of habitat’ and many wrote about only the habitat. The most credited response was prevention of overhunting or poaching.

(c) This question was answered well by candidates, and many were gained full marks.

(d) The term biodiversity was not well known by candidates. Some were able to give the idea that it was lots of different species but failed to say the number of different species. Many candidates thought it was the number of different organisms.

(e) Some candidates correctly identified the need to plant more trees as they are removed. However, some did not relate their knowledge about sustainability to the example given. Some simply referred to burning the wood.

Question 7

(a) The responses to this question were very variable. Many candidates were able to gain 5 or 6 marks, but some scored very few marks.

(b) Most candidates were able to gain a mark for recalling that proteins are made from amino acids. Fewer were able to correctly identify that fats are made of glycerol.

(c) This was answered well but some candidates thought the answer was vitamin C.

(d) Most candidates were able to correctly state the use of calcium in the body and many were able to link iron with haemoglobin or reducing anaemia.

(e) The most common answers were carbohydrate and water.

BIOLOGY

Paper 0970/32
Theory (Core)

There were too few candidates for a meaningful report to be produced.

BIOLOGY

Paper 0970/41
Theory (Extended)

Key messages

Understanding the command words used in these exam papers is crucial for success. Some candidates did not respond appropriately to the instructions to describe and to explain.

Candidates should make sure that they pace themselves when taking this paper and ensure that adequate time is allowed to answer the whole paper.

Candidates should read the questions closely. The text and any accompanying illustrations often give clues as to how to answer the question. Some questions in this paper stated information which was often repeated in the answers. For example, some candidates gave 'mammals' as a response to **Question 1(b)**. In **Question 1(f)** many candidates wrote the names of veins into the column headed artery.

General comments

Handwriting was important in **Question 4(a)(i)** as it was sometimes difficult to tell when candidates were writing about lactose the sugar or lactase the enzyme. This was also the case in **Question 7(b)(ii)** when it was unclear whether some candidates had written lag or log. If candidates change their minds about an answer, they should cross out the first attempt and rewrite their answer elsewhere, rather than overwriting an answer.

Care should be taken when describing patterns and trends on line graphs. Many stated that the transpiration of the leaf 'stops' as the temperature increases, rather than stating that the rate remains constant or remains at a maximum. Alternatives that are accepted are 'plateau' and 'levels off', but remains constant is preferred. Many also thought that in region **Y** of the graph in Fig. 5.1 the stomata closed. If that were the case the rate would have decreased and possibly reached zero or have remained at a very low rate.

Some candidates confused terms. In **Question 5** they often started writing about transpiration but then wrote respiration. Some wrote respiration throughout their answers, but this happened much less frequently.

Candidates need to check table headings when completing tables. In **Question 2(b)** Table 2.1 was sometimes incorrectly completed with 'name of the part' placed in the 'letter on Fig. 2.2' column and *vice versa*.

Few candidates wrote about energy production in respiration. While explaining that mitochondria are present in larger numbers in root hair cells than in palisade cells in **Question 3(a)**, some candidates wrote that mitochondria 'produce energy'. They gained credit only if they said that mitochondria release energy or provide energy. Some knew about ATP and wrote that mitochondria produce ATP for the root hair cells which was accepted.

Question 6(a)(ii) asked for an explanation of the trend seen in Fig. 6.1 - a chart showing the decrease in cases of polio following the introduction of a vaccine for the disease. Many candidates wrote excellent explanations, but a sizeable number simply described the decrease in numbers from the chart.

Comments on specific questions

Question 1

(a) The majority of candidates identified fins and scales as features that fish do not share with amphibians. 'Gills' was a common response, but as the question asked for visible features was not

accepted. The operculum is visible and was accepted. Many stated that unlike the amphibian the fish does not have any limbs. Legs, arms and feet were accepted as alternatives to limbs.

(b) Reptiles and birds were given by almost all candidates. Candidates who wrote 'mammals' had not read the question carefully. A small number gave an invertebrate group, such as arthropods.

(c) There were many comprehensive answers to this question comparing the circulatory systems of fish and amphibians. Many candidates started by stating that the fish has a single circulation, and the amphibian has a double circulation, but several only stated the type of circulatory system found in one of the organisms, not both. Those who described the two systems often omitted to state that blood flows once or twice through the heart in each circuit of the body. Many thought that the amphibian has a four-chambered heart even though Fig. 1.4 shows that no septum exists. The circulation in amphibians is often known as an incomplete double circulation. There is an effective separation of oxygenated and deoxygenated blood in amphibians but the structures responsible for this are not visible in the diagram. Many did not identify the fact that blood is oxygenated in the skin as well as in the lungs in the amphibian circulation. Many observed that there are valves in both circulatory systems, but few stated that the diagrams show that amphibians have three in the heart compared to one in the fish. To gain full marks candidates had to give at least one similarity and one difference between the two circulatory systems.

(d) Most candidates stated that mammals have a double circulatory system and can pump blood at high pressure so having a faster or more efficient supply of blood or oxygen to the body. Some answers described the pulmonary circulation explaining that blood flows at a lower pressure so reducing the chance of damage to capillaries in the lungs and facilitating gas exchange. Quite a few candidates stated that there was more blood flowing rather than the blood flow was faster or more efficient.

(e) Answers to this question on the relationship between the structure and function of arteries and veins was answered well by many candidates. Others stated the structural features, such as arteries having thick walls and veins having wide lumens without then linking these to an appropriate function associated with blood pressure. The most common answer was the presence of valves that prevent back flow of blood in veins. Good answers stated that the thick walls of arteries withstand the high pressure of blood and that the large lumen allow large volumes of blood to flow at low pressure towards the heart. Even better answers referred to the elastic tissue in arteries that stretches and recoils with the change in pressure.

(f) Many candidates identified the pulmonary artery, kidney and hepatic artery in Table 1.1. Some candidates wrote the names of veins in the second column despite the table heading asking for an artery.

Question 2

(a) (i) Most candidates gave the range as 28 or 28.0 °C to 39 or 39.0 °C or did a subtraction to give it as 11 °C. Some candidates misread the figures from the graph.

(ii) There were many excellent answers to this question in which candidates stated that body temperature is maintained by homeostasis followed by ways in which the brain controls heat loss and heat conservation. Candidates were not always as secure when writing about how the responses to high and low environmental temperatures are detected. Responses that differentiated between receptors in the skin detecting outside temperature and sensors in the brain detecting blood temperature were very rare. The best answers stated that sensory receptors or sensory neurones in the skin detect changes in the skin temperature and send impulses that travel to the brain or often the hypothalamus. Of those who stated impulses, rather than signals, many correctly stated the brain sent impulses through motor neurons to effectors but did not specify these were in the skin. Candidates more rarely stated that impulses are sent along motor neurones to effectors, such as hair erector muscles, sweat glands and the muscles that contract to generate heat by shivering. There were good descriptions of vasodilation and vasoconstriction. Weaker answers did not explain the processes, instead, they often gave detailed descriptions of the temperature changes shown in Fig. 2.1. There were no marks for any descriptions of the trends shown in the graph or to the use of data. Some answers included a list of methods to lose or conserve heat without linking then to an increase or decrease in body temperature. Quite a few answered this question by discussing what happens to enzymes if the body temperature gets too high rather than how the body temperature is maintained.

(b) Most candidates gave fat, fatty tissue or hair in row 1 of Table 2.1. Candidates often did not name the hair erector muscle correctly (**E** on Fig. 2.2) and also did not make it clear that contraction of the muscle leads to the hair being raised and/or lowered when the muscle relaxes. Many gave receptor, sensor or sensory neurone and **B** for the last row.

Question 3

(a) This question received many excellent answers. Most candidates stated that there are more mitochondria in the root hair cell than in the palisade cell and the latter has chloroplasts while the root hair cell has none. Explanations referring to active uptake of ions by root hair cells and photosynthesis in palisade cells were often very thorough. However, there were also some who stated that energy is required for the active uptake of water. Many candidates stated that chloroplasts absorb light but did not complete their answer by stating that they convert light energy to chemical energy for the production of carbohydrates, such as glucose. Many also omitted to state that mitochondria are the site of aerobic respiration.

(b) (i) A common error was to omit the word 'same' or 'similar' when describing the cells comprising a tissue. There was no credit for identifying area **A** as phloem tissue, however, some candidates stated that transport of sugars is the function of the cells in the tissue.

(ii) Many candidates gave two features of the xylem vessel labelled **B** on Fig. 3.3 and many also explained how the features are adaptations for transport of water, although this was not required by the question. Cell walls with lignin and hollow or no cell contents were common answers. Quite a few gave essentially the same marking point for the idea of the xylem being a long hollow tube. Often lignin was mentioned, but without stating that it is in the cell wall.

(iii) A variety of adaptations shown by leaves of xerophytes were seen. Again, it was not necessary for these to be explained. Small leaves, leaves reduced to needles or spines and few stomata were common.

(iv) Most candidates stated that the roots of xerophytes are long or deep. Fewer stated that a different adaptation is to have roots that spread widely just below the surface of the soil. Candidates who wrote that there are many root hairs or that roots have a large surface area did not gain credit as these are features of almost all plants including many that are not xerophytic.

Question 4

(a) (i) Many candidates realised that lactase broke down lactose in the milk sample in row 1 of Table 4.1. Fewer realised that lactase would have been used to break down lactose in the milk used to make 'lactose-free milk'. There were many good explanations as to why lactose did not break down sucrose often using their knowledge of enzyme action. Weaker answers simply described the results in the table without offering any explanation. Some candidates were confused by the brown colour of the indicator thinking that it must be iodine. This led them into a discussion about the breakdown of starch. A few assumed that the indicator was Benedict's solution and wrote about lactose being broken down to reducing sugars which was accepted. In fact, the 'indicator' in this investigation is a test strip that is specific to glucose and does not change colour with other reducing sugars.

(ii) Many candidates started their explanation for using a temperature close to the optimum for lactase by stating that as the temperature increases the activity of the enzyme, or rate of the enzyme-catalysed reaction, increases. This simple statement did not gain credit as it is not true if the temperature range extends beyond the optimum temperature. Better answers either explained what happens at the optimum temperature in terms of speed of reaction and/or mode of action or what happens as temperature increases to the optimum and when it increases above the optimum. Almost all answers explained that denaturation would occur, although they did not always state that this happens at temperatures above the optimum. There were many good answers using enzyme-substrate complexes and the complementary shapes of substrate and active site. A minority of candidates took a different approach and stated that temperature is a key variable and must be standardised. The highest rate of reaction should be described as the maximum rate not the optimum rate. A common misconception is that enzymes will denature at both high and low temperatures.

(b) (i) Most candidates gained two marks for identifying that vitamin D is required for healthy or strong bones and teeth and that it prevents rickets. A smaller number stated that milk is a good source of calcium or that vitamin D stimulates the uptake of calcium in the gut and its use in bones and teeth.

Candidates should know that vitamin D deficiency does not lead to scurvy and that vitamin D is not the source of calcium.

(ii) Candidates found it harder to describe what is meant by a balanced diet. Good answers stated that the diet must have all the food nutrients or food classes in correct proportions. Fewer went on to explain that many factors affect what constitutes 'correct proportions', but some gave age, gender, pregnancy or activity as examples of factors that influence the amount of energy and the amounts of different nutrients that should be in the diet. Some candidates tried to remember the names of all the nutrients required, but often missed one - usually fibre - and so did not gain credit as all seven were required for the relevant marking point. Candidates should know that a meal is not a diet.

Question 5

(a) This question was sometimes misinterpreted by candidates who explained the results shown in the graph in Fig. 5.1 rather than simply describing them. Good answers stated that the rate of transpiration for both surfaces of the leaf increased and then remained constant as the temperature increased. Some described the trend for transpiration but did not include a mention of temperature. Both variables should always be mentioned when describing a trend or pattern from a graph. Many also stated that the rate was higher for the lower surface although they rarely added 'at all temperatures'. Some noted that the increase was steeper for the lower surface and even fewer that the rates for the two surfaces became constant at the same temperature. Weaker answers often stated that the rate of transpiration stopped or that transpiration stopped instead of stating that the rate remained constant. Some stated that the rate decreased before stopping.

(b) Many wrote descriptions of the data shown in Fig. 5.1 rather than explaining the shape of the curve for the upper surface at the regions of the graph labelled **X** and **Y**. Some candidates were confused about where stomata would be on the surfaces of the leaf and therefore did not explain that there would be evaporation from the surface of mesophyll cells and diffusion of water vapour out of stomata on the upper surface. If they did, then they also referred to an increase in kinetic energy of the water molecules as temperature increases. Some stated that as temperature increases the stomata opened wider or more stomata opened. All were acceptable reasons. Candidates often stated that temperature is a limiting factor at **X** and also many were able to state that it was no longer a limiting factor at **Y**. It proved more difficult to explain why the rate of transpiration remained constant over the temperature range in region **Y**, although many stated that a factor other than temperature must be limiting the rate of transpiration. Likely factors identified by candidates included humidity, light intensity, and less often, number of stomata. A minority stated that the rate of absorption of water is likely to be at a maximum and that this would limit the rate of transpiration.

(c) Most candidates stated that there are more stomata on the lower surface as the difference between the structure of the two surfaces of the leaf. Others identified the fact that the lower surface has a thinner cuticle. Many stated that the lower surface has a larger surface area which would only make sense if there were grooves or pits and none of the candidates stated this.

Question 6

(a) (i) Most candidates extracted the correct number of cases of polio from the chart in Fig. 6.1 as 220 and 80 and showed a subtraction to work out the decrease as 140. Many then calculated the percentage decrease correctly and gave their answer as – 64% or stated that there was a 64% decrease. Common errors were to use the incorrect denominator, give the answer to more than two significant figures and to omit the minus sign or the word decrease.

(ii) There were many detailed answers to this question on vaccination, often gaining most of the marking points available. Some candidates stated that the type of immunity involved is passive rather than active and some stated that antibodies form memory cells or omitted to mention the source of the memory cells altogether. A large number explained that the large uptake of the vaccine resulted in herd immunity, and some went further to explain that this provides protection not only for the vaccinated, but also for those who for medical reasons cannot receive the vaccine. Antibodies may 'fight' disease is too vague and is not credited.

(iii) Candidates often found it difficult to explain why the polio vaccine does not protect people from other diseases. The best answers used the term specific to describe the effect of the antigen in the vaccine or the antibodies produced in the immune response to the antigen. These answers often explained that the antibodies have a shape that is complementary to the antigen and so they can only bind to

the polio antigen and not to any others from the pathogens that cause other diseases. Many answers appeared to show a correct understanding, but the detail provided, or the wording of the answers was not precise enough to gain credit.

(b) The descriptions of blood clotting were often very good. Almost all candidates ended by stating that clotting prevents the entry of pathogens. A common error was to confuse fibrinogen with fibrin and insoluble with soluble. For example, 'the insoluble fibrin is converted to the soluble fibrinogen' and 'fibrinogen (insoluble) is converted into fibrin (soluble)'.

(c) Almost all candidates gave plasma as the name of the component of blood that transports blood cells. Those who wrote 'red blood cells' clearly had not read the question fully.

Question 7

(a) The flow chart in Fig. 7.1 showed the stages of eutrophication. Many candidates completed the six boxes correctly. Fertiliser and nutrients were often given to complete box 1, but were not accepted in favour of named ions, such as nitrate, phosphate and ammonium. The were many different spellings of algae and if recognisable they were accepted. The word to complete the final box was dissolved, but fewer got this correct.

(b) (i) Few candidates gave the correct name for the shape of the bacterial growth curve as sigmoid. S-shaped was a common answer but was not accepted. There was a very large number of other answers - all incorrect. Exponential was one of the more common responses.

(ii) More candidates were successful here as they gave lag as the name of the initial phase of bacterial growth. 'Log' was the most common incorrect answer. Sometimes it was not clear whether the candidates meant lag or log and benefit of the doubt could not be given.

(iii) The most common correct factors that would cause bacteria to die in the flask were toxins or waste, pH, high temperatures, disease and overcrowding. Many answers were resources, such as lack of food or lack of space, that were ruled out by the wording of the question.

BIOLOGY

Paper 0970/42
Theory (Extended)

Key messages

When asked to use label lines to label a structure on a diagram, candidates should ensure that their label lines touch the relevant structure. They should avoid using arrowheads at the ends of the lines as these can be ambiguous.

Candidates should be aware that questions without answer lines can be easily missed; they should look down the right-hand side of the question paper to find the mark allocations to check that they have answered each question. They should also read all the instructions for calculation questions. Often the answer needs to be given in a specific way, such as to a certain number of significant figures or the unit needs to be included.

Rereading answers is particularly important if candidates have decided to cross out part of a response. This is to check that the answer still makes sense and does not contain contradictions.

General comments

Questions that relied predominantly on subject knowledge, such as naming gases involved in the enhanced greenhouse effect (**Question 1(e)**), the mineral ions needed to make chlorophyll (**Question 4(a)**), the function of rods and cones (**Question 2(c)**), the function of the placenta (**Question 5d(i)**) and the function of the amniotic sac (**Question 5(d)(i)**) were answered well. Similarly, questions requiring candidates to state distinguishing features of mammals (**Question 5(a)**) or between plants and fungi (**Question 1(a)(ii)**) were answered with appropriate detail. However, the questions that focused predominantly on subject knowledge and required long responses, such as **Question (4)(c)(ii)**, often contained relevant information but with insufficient detail to gain credit. Where candidates were prompted in a cloze question (**Question 6(a)**), they were usually able to provide the appropriate terminology.

In contrast, the questions that required candidates to use information in diagrams, such as using the letters in Fig. 2.1 to describe accommodation in **Question 2(b)(iii)**, identifying the limiting factors on Fig. 4.1 (**Question 4(b)(ii)**) was more challenging. This showed that many candidates were less proficient at answering questions that required application of knowledge and understanding compared with those that required simple recall of knowledge.

Most candidates seemed familiar with the theory underpinning investigations into yeast respiration in **Question 1(c)**. Candidates gave comprehensive explanations for the reason why no carbon dioxide was produced at high temperature in **1(c)(iv)**, but many candidates were much less confident in their explanations of the results of the investigation of light on photosynthesis in algae using hydrogencarbonate indicator in **Question 4(b)(i)**. This suggests that these candidates would benefit from linking their understanding of the theoretical concepts with experimental results.

Question 1

(a) (i) Most candidates knew that the role of the mitochondria was to carry out aerobic respiration. Some candidates did not specify the type of respiration and others used the colloquial phrase that they are the 'powerhouse' of the cell.

(ii) Many candidates identified a feature that distinguished plants from fungi. The most common were the presence of chloroplasts and the cellulose cell wall. A few candidates wrongly stated that fungi do not have a cell wall.

(b) Most candidates realised that the type of respiration that produces ethanol in yeast is anaerobic respiration and made an attempt at writing the balanced chemical equation by stating the formula for glucose on the left-hand side of the equation. Fewer candidates knew the chemical formula for ethanol and so many were unable to balance the equation correctly.

(c) (i) Almost all candidates read the correct values from the graph to calculate the rate of respiration. Many candidates went on to calculate the rate and give the correct units. Some candidates thought that they needed to calculate a percentage change and others used 'm' as an abbreviation for minutes, perhaps forgetting that this is the SI unit for length.

(ii) Many candidates incorrectly assumed that the oil layer in this experiment was there to prevent evaporation. These candidates may have been thinking about a transpiration investigation. However, many candidates were familiar with the use of oil in this context and explained that it prevented the oxygen from entering the solution. Some of these candidates referred to air or gas and were not sufficiently precise in their reference to oxygen being the key gas to prevent from entering the solution.

(iii) Many candidates realised that the reason no more carbon dioxide was produced was because all the glucose had been used up. Fewer candidates mentioned that the build-up of ethanol may have killed the yeast or rendered it inactive.

(iv) Many comprehensive answers were given to explain why no carbon dioxide was produced when the temperature was 95 °C. Some candidates wrongly assumed that yeast is an enzyme and that it, rather than the enzymes, is denatured.

(d) The most common use given for the carbon dioxide produced by yeast was to make dough rise or make bread, but many knew that carbon dioxide enrichment is used in greenhouses to improve crop yields. Common incorrect answers included ‘as a biofuel’ and ‘making wine’. This suggests that these candidates did not read the question carefully and thought it meant any use of yeast.

(e) Methane was mostly commonly given as a greenhouse gas. The most common incorrect answer was carbon monoxide.

Question 2

(a) Many comprehensive definitions of a sense organ were seen. Fewer candidates were credited with the mark point about receptors than the second mark point about detecting stimuli.

(b) (i) Many candidates correctly identified the motor neurone on Fig. 2.1. Those candidates who followed the instructions and used a label line and label X were able to carefully place the end of the line directly on the neurone. An X placed directly on top of the neurone was accepted as were arrows if they touched the correct neurone.

(ii) Many candidates gave a detailed account of the events that occur at a synapse to generate an impulse in the next neurone. Almost all candidates knew that neurotransmitters are involved and many of these candidates went on to describe their release from vesicles and their diffusion across the synaptic gap. A few candidates described the receptor molecules on the post-synaptic membrane as cells or gave them an incorrect name such as ‘receiver’ molecules.

(iii) Those candidates who used the correct letters from Fig. 2.1 were often the same candidates who described how the eye focusses on near objects. Some candidates described the suspensory ligaments and ciliary muscles as being a pair of antagonistic muscles. Another common misconception was to think that the more convex lens will refract more light rather than idea that the light is refracted more.

(c) Most candidates knew that rods and cones are found in the retina and many also knew that there are only cones found at the fovea. Only a few candidates mentioned that there are no rods and cones at the blind spot. Many candidates correctly described the roles of rods and cones, though some confused the two and others used incorrect statements, such as cones being red, green or blue, rather than the idea that they absorb different wavelengths of light. Many wrote that rods and cones see light rather than detect it.

(d) (i) Almost all candidates knew that an alternative version of a gene is an allele. The most common incorrect response was genotype.

(ii) Many candidates correctly stated the genotype of a male with colour blindness as X^aY. Some candidates used lower case letters for the 'X' and 'Y' chromosome, and this was accepted. X^AY was the most common incorrect answer.

Question 3

(a) (i) Most candidates indicated at least a few of the processes on Fig. 3.1 that were mitosis or meiosis, but only a minority correctly identified all of them. The most common points to be confused were **S** and **T**.

(ii) Almost all candidates knew that process **W** in Fig. 3.1 was fertilisation.

(iii) The first three words inserted into the sentences about stem cells and body cells were usually correct, but many candidates thought that some genes are either not present or not the same in particular cells, or that the cell only makes specific genes that it needs.

(b) Those candidates who used Fig. 3.1 to identify which processes would not occur during asexual reproduction often correctly stated these as **P** and **W**. Those candidates who described the processes without using the letters sometimes made errors, such as describing fertilisation as the fusion of eggs and sperm, rather than the nuclei of these cells.

Question 4

(a) Magnesium was most commonly given as an ion that is needed to make chlorophyll. Nitrogen was a common incorrect answer.

(b) (i) Some very detailed answers were seen to explain the results of the investigation using the two test-tubes of algal balls, one in the dark and the other in the light. Most candidates realised that light was required for photosynthesis, but fewer connected this with the use of carbon dioxide and the subsequent increase in pH. There were a considerable number of candidates who did not mention respiration at all or focussed on changes in oxygen concentrations rather than carbon dioxide. It is likely some of these candidates did not read the statement that told them that carbon dioxide is an acidic gas. Others did realise the involvement of carbon dioxide but were confused about the direction in which the pH would change with the addition and removal of carbon dioxide. Parts of some answers were crossed out and rewritten, but this often led to statements that were contradictory. Candidates should reread their answers to ensure they convey what they mean to say.

(ii) Fig. 4.1 was a graph showing the effect of light intensity on the rate of photosynthesis. Many candidates thought that there was more than one limiting factor at **X**, or that light intensity was limiting at **Y**. Others were too vague when they suggested that carbon dioxide could have been limiting at **Y**. Nevertheless, some very confident answers were seen with some candidates identifying light intensity at **X** and going on to mention many more correct limiting factors at **Y**, including carbon dioxide concentration, than was required for full credit.

(c) (i) Most candidates knew that the tissue that transports sucrose is phloem, with a few suggesting xylem or writing a word that was a hybrid between the two words such as 'phyolem'. Many candidates also knew that amino acids are a biological molecule that is transported in the phloem, but a wide range of incorrect biological molecules were also seen.

(ii) Although most candidates gained some credit for their descriptions of the digestion of starch, only the most well-prepared candidates gained full credit. It was quite common to see candidates go beyond the scope of the question to describe absorption or to only focus on chemical digestion and omit details of mechanical digestion. A few knew that enzymes were involved but did not describe the details.

Question 5

(a) Almost all candidates identified either the fur or external ears as a visible distinguishing feature of the mammal in the photograph. The most common incorrect answer was four limbs.

(b) Many candidates knew that genetic variation is an advantage of sexual reproduction, but fewer candidates went on to give other points in sufficient detail to gain credit.

(c) Many candidates correctly identified and named the oviduct and uterus lining from Fig. 5.2. Although many gave a correct function for the ovaries, some incorrectly identified their position. Many candidates did have some idea about one of the functions of the cervix, but some of these responses were vague, or described a child rather than a foetus being held in the uterus. There were many phonetic variations on the word oviduct that were accepted. A few candidates stated that the ovary was the site where ovules were produced.

(d) (i) The function of the placenta was well described with all the expected mark points found on the scripts. A few candidates did not specify the direction of exchange of nutrients and waste or used the term food rather than nutrients. Many gave correctly named nutrients in their answers.

(ii) The function of the amniotic sac was well known. The most common correct response was protection from mechanical shocks, but a considerable number of candidates stated protection without qualifying their answer further. This qualification was particularly necessary because some candidates thought that it offered immunity. A few candidates confused the functions of the placenta with those of the amniotic sac.

Question 6

(a) Almost all candidates knew that ingestion was the name of the process of taking in food to the mouth. A few candidates confused the incisors with the canines, but most candidates did know that the molars and premolars are found at the back of the mouth and are used for chewing food.

(b) (i) Most candidates correctly labelled the lacteal and capillary, but as in **Question 2 (b)(i)**, a number of candidates did not label Fig. 6.1. A small number of candidates labelled the capillary and lacteal where they crossed each other, rather than finding an unambiguous place on the diagram to position their label lines.

(ii) Almost all candidates knew that villi are in the small intestine.

(iii) Some candidates gave a correct function of the lacteal. The most common errors referred to digesting rather than absorbing or transporting lipid or their break down products. Some candidates also stated incorrectly that blood was found in the lacteal.

(c) Only a few candidates gained full credit for describing the pathway of the products of protein digestion to the liver. Many candidates misread the question and described the breakdown of amino acids in the liver or described the absorption of protein rather than amino acids. There was also a considerable number of candidates who confused the hepatic portal vein with the hepatic vein or hepatic artery.

BIOLOGY

Paper 0970/51
Practical Test

Key messages

Candidates should ensure that they read the questions carefully before starting to answer. This is particularly important for any planning exercise that is required. Identification of the dependent and independent variables is vital before a plan is completed. Controlled variables must also be considered and included in a plan.

When asked about safety considerations, candidates should identify a risk, but also identify a method of reducing that risk.

Mathematical calculations form an important part of the practical assessment. It is essential that candidates check all their working carefully and take time to consider whether the resulting answer is realistic.

It is essential that candidates take time to ensure that their written work is legible. This includes the avoidance of 'overwriting' when mistakes are made or even writing in pencil and then overwriting in pen. When mistakes are made, they should be crossed out completely and the alternative answer written in a suitable clear space.

General comments

Most candidates performed well on this paper. Some of the questions relied on a good knowledge of a variety of food tests. It was clear that although most candidates had experience of food testing in a practical context, a large number were less sure of the techniques involved or of the outcomes expected.

For the graph question, candidates demonstrated a good ability to plot quite complex data with good attention to detail, but care needs to be given to selecting appropriate scales.

Most candidates understood the key points when drawing the specimen, but care should be taken to avoid shading.

Comments on specific questions

Question 1

(a) (i) For this question it was particularly important that candidates followed the instructions as they progressed through the procedure. For those who did, columns were recorded for the volume of DCPIP remaining in the syringe as well as a column for the volume of DCPIP added to the test-tubes. Some candidates only recorded one of the columns and it was not always clear which one they had recorded. Despite this, most candidates did reasonably well in recording their data, and most saw the expected trend in the results. Headings for the table were suitable and included correct units. Common errors included writing units in the body of the table or using 'm' as a unit for time.

(ii) Many candidates found this question demanding and described the colour change with DCPIP or the volume of DCPIP added, rather than relating it to the concentration of vitamin C. Many also found the link between the time in the hot water and the concentration of vitamin C difficult to describe, with some referring to temperature rather than time. Several candidates also stated that vitamin C decreased in the fruit the longer it was in the hot water, although this was not the variable being measured.

(b) (i) Candidates also found this question demanding, with many stating that the independent variable was the temperature of the water or the volume of the DCPIP.

(ii) The purpose of the foil wrapped around the beaker was very well described by nearly all candidates. A few referred to blocking out light, but most gave good descriptions of maintaining temperature.

(iii) Most candidates correctly explained why removing air bubbles from the syringe would be important. Answers that only referred to improving accuracy were insufficient to gain the mark.

Question 2

The planning activity asked candidates to plan an investigation for photosynthesis in an aquatic plant. It was clear that some candidates had a very good understanding of the procedure used to study the effect of light intensity on a plant such as *Elodea*, possibly reflecting practical work that they had performed in lessons. Others had less of a clear plan and tended to refer to starch testing in de-starched leaves or the measurement of reducing sugars. Most candidates identified the need to change light intensity, and most could describe a way of doing this, usually by moving a bench lamp. The controlled variables were also well described. Safety issues were described by a large proportion of candidates, but these needed to be specific to the practical procedure and not general safety such as the wearing of gloves or goggles.

Question 3

(a) (i) The drawing of the section of persimmon fruit was well done with some very good clear diagrams. Shading is not appropriate in biological drawings. It is important that candidates observe the arrangement and position of internal detail and correctly put this in their drawings. A significant number of candidates had the wrong number of seeds or drew them in the wrong positions.

(ii) Most candidates were able to measure line **PQ** correctly and calculate the actual diameter. All working should be shown when doing any calculation, as marks can be awarded for showing how calculations were done, even if the final answer is incorrect. It is important that candidates understand the difference between decimal places and significant figures.

(b) (i) The reagents used to test for starch and protein were known by the majority, but a significant number of candidates confused them with tests for reducing sugars.

(ii) Fewer candidates were able to describe the emulsion method for testing for fats. Many understood the need for ethanol, but few described the dissolving of fats in ethanol followed by the formation of an emulsion with water. It is important that candidates are familiar with all the food tests.

(c) (i) Identification of the dependent variable in this investigation was demanding for a significant number of candidates. Many gave answers that were vague, such as ‘juice’ rather than referring to the volume. Others gave controlled variables such as temperature or pectinase concentration.

(ii) Most candidates could state one controlled variable. Some stated that the mass of the chopped apple was constant, however the procedure simply stated that mass was measured, but not controlled. Candidates need to make sure that they read the stem of the question very carefully.

(iii) Cutting apples and the use of pectinase enzyme were the most common hazards identified by candidates. However, not all candidates went on to describe a precaution in adequate detail. Simply stating that a knife should be used with care is insufficient.

(iv) The use of repeats to identify anomalous results is a concept that all candidates should be familiar with. An average can be found from repeated values, but this is not why they are done. Similarly, repeating a procedure will not make it any more valid or accurate.

(v) Most candidates found this question demanding. A control would have been replacing the pectinase with an equal volume of water or boiled enzyme solution. Few candidates noticed the crucial aspect of the volume having to be equal.

(d) (i) Although the calculation of the volume was done well by most candidates, fewer were able to give the units correctly. The most common error was using cm^3 per g rather than just cm^3.

(ii) One of the criteria for plotting points on a graph is that they take up more than half of the available grid. Most candidates found this difficult to achieve as they started plotting values of the volume of liquid at zero. It should be remembered that the axes of a graph do not have to start at zero. It is also

important that small points or crosses are used to denote a plotted point, as many of the points were too large. The line drawn should be a neat line of best fit or line joining each point, with no extrapolation at either end. Most candidates were able to correctly label the axes, copying the headings from the table of data.

(iii) When answering a question candidates should note the number of marks available. In this case, two marks were available, suggesting two points of interest from the graph were required. Many candidates simply described the increase in volume as concentration increases and did not go on to describe the levelling off of the line at 0.8%.

BIOLOGY

Paper 0970/61
Alternative to Practical

Key messages

As well as stating the independent and dependent variables when planning an investigation, candidates should also make sure that they describe how the independent variable will be changed and how the dependent variable will be measured. In Question 2, the independent variable might have been changed by changing the distance between the plant and the lamp. The dependent variable might have been measured with a gas syringe, to measure the volume of oxygen produced.

When considering hazards and safety considerations in an investigation, candidates should think carefully about what might be relevant to that particular investigation. For example, a water-bath at 37 °C is not hot enough to cause burning, but when using enzymes you should wear gloves for protection.

When drawing graphs candidates should plan their scale before starting. The scale must be linear and large enough so that the plotted data occupies at least half the grid in both directions. Many candidates drew graphs with a scale that was too small on the *y*-axis. Many also extrapolated their lines beyond the data points. This should be avoided. Candidates should also be reminded to either make an indication on the axis, or not put a zero at the origin if they are truncating the scale.

General comments

Some good drawings were seen, with many candidates gaining all four marks. Few candidates included shading in their drawings and most included a good level of detail. Care should be taken when rubbing out that all lines intended to be rubbed out are erased.

Tables were generally drawn well. Incomplete headings or units in the data cells were the most common errors.

Comments on specific questions

Question 1

(a) (i) The majority of candidates were able to calculate the volume of DCPIP added as 3.4 cm^3.

(ii) Most candidates drew good tables with a column for time and a column for the volume of DCPIP added. The most common mark missed was marking point 2 as some candidates included units in the data cells, or the units were missing from one of the headings. Occasionally, the unit for time was given as 'm' rather than minutes. The letter 'm' is not an acceptable abbreviation for minutes as it is the abbreviation for metres. Some candidates also omitted the word time and simply wrote minutes as the heading. Some redrew Fig. 1.1 as their answer. This was given marking point 3 only if they had included their calculation for volume added at 5 minutes.

(iii) At the start of the question candidates were told that 'a student investigated the effect of cooking time on the vitamin C content of the water'. Therefore, the conclusion to this investigation should describe the relationship between cooking time and the vitamin C content of the water, i.e., the greater the cooking time, the more vitamin C diffused into the water. Many candidates instead focused on the DCPIP and described the relationship between the volume of DCPIP added and the volume that remained in the syringe. Some said that the greater the time, the more DCPIP added or the less DCPIP remained, but these just describes the results and do not reach a conclusion.

(b) (i) Candidates should have stated that the independent variable was time. A common error was to give the volume of DCPIP.

(ii) Many candidates recognised that the beaker was wrapped to insulate it. This was described in a variety of ways, such as to maintain the temperature or avoid heat loss. A common incorrect answer was to say that the foil prevented light from entering the beaker. Others said that the foil was to prevent burning when holding the beaker or to prevent it breaking.

(iii) Some vague answers were given, such as to increase accuracy. These did not gain a mark. The idea that the air was removed to make sure the volume of DCPIP was 5 cm^3 was expressed in several ways. Other incorrect answers included ideas that the gas would not react with the DCPIP.

Question 2

Some good plans were seen with many candidates getting full marks for this question.

It was apparent that candidates were familiar with this investigation and could recall the method. Many described having the same species of aquatic plant different distances from a light source and using a gas syringe to measure the volume of gas produced in a set time. Many mentioned the use of a heat shield and time for equilibration.

Those that thought that the plants release carbon dioxide did not get a mark for describing the dependent variable. Some candidates proposed methods for measuring photosynthesis which were inappropriate for measuring rate, such as using starch tests, bicarbonate indicator or growth over time.

Candidates need to describe safety measures relevant to the investigation, rather than just stating that goggles and gloves need to be worn in every investigation. In this investigation, a safety measure might have been cutting away from the body when cutting the pond plants. Many candidates correctly stated that the investigation needed to be repeated more than once, rather than just repeated.

Question 3

(a) (i) Some accurate drawings were seen showing an appropriate level of detail: the correct number of seeds and indents on the left, top and right sides. Most were a good size, although some were too small and some just touched the text at the top. Few candidates resorted to compass-drawn circles, and the majority showed good observational skills in accurately depicting the outline.

(ii) Line **PQ** was generally measured accurately, and the correct calculation was given to three significant figures. It was clear that some candidates were not familiar with the idea of significant figures. Candidates should read all instructions carefully. For example, to see whether the answer should be given to a certain number of significant figures, decimal places or rounded to a whole number. Some candidates gave their answer in centimetres rather than millimetres, but they did not change the units. If units are given in a question, candidates should give their answer using those units, rather than changing them. Despite being given the calculation, many candidates multiplied by 2.2 rather than dividing. However, these candidates could still get the third marking point if they had shown their working and that they had rounded to three significant figures.

(b) (i) Food tests were generally well known by candidates. Candidates should learn the correct spellings for iodine and biuret. Some gave Benedict's rather than biuret. The most common error for the starch test was amylase.

(ii) Many candidates could only partially recall how to test plant tissue for fat. Some knew it was the emulsion test and some could say that it turns cloudy but neither response fully answered the question. Those that did describe the method often knew that ethanol was needed but forgot the addition of water. Some omitted to say that the combination is shaken. Good answers described the sample being shaken with ethanol and then added to water and shaken. This test seemed to be less well known by the candidates than the starch and protein test.

(c) (i) Candidates find it more difficult to describe the dependent variable than the independent variable. A variety of answers were seen, for example, mass of apples, volume of pectinase, concentration of pectinase and temperature.

(ii) Most candidates were confident in their ability to describe the constant variables. Temperature and the volume of pectinase were common answers. Time unqualified was not enough for a mark. Candidates should have said the time in the water-bath. The question stated that the mass of

chopped apples was measured, but not that the mass was kept constant, so this was not a correct answer.

(iii) Many candidates chose to describe the hazards associated with cutting and the precaution to cut away from the body, or on a hard surface. Cutting carefully or asking an adult to help was not sufficient for the second mark but was commonly seen. Use of gloves while cutting was ignored as depending on the type of glove used, this may not make use of a knife safer. Some also realised that the enzyme pectinase can cause a skin reaction and so advised wearing gloves. Hazards associated with use of a water-bath were ignored as the water was at 37 °C, so was not hot enough to cause burning.

(iv) Some vague answers were given to this question, such as improvements to accuracy and reliability. The best answers described how anomalous results can be identified if several sets of results are collected. Many candidates believed that the idea of being able to calculate an average was particularly important. Candidates should take care in how they describe the identification and elimination of anomalies, as some responses give the impression that repeats would mean anomalies do not occur. Answers that described avoiding or preventing anomalies could not be given credit.

(v) This was a one-mark question, and candidates need to state not only that water, or boiled/denatured pectinase, should have been added instead of pectinase, but also that 50 cm^3 should have been added (the same volume as pectinase). Many did say that water should be added but did not give the volume. Very few referred to the use of boiled or denatured pectinase.

(d) (i) The correct answer was calculated by multiplying 0.92 by 150 to give 138. Many candidates gave the correct units as cm^3 but did the wrong calculation. Other candidates incorrectly gave the units as g / cm^3 or omitted the units completely.

(ii) Many different graphs were drawn but very few drew bar charts. Axes were usually labelled correctly, and most plotted the data points accurately. However, most of the scales given meant that the data did not occupy at least half the grid in both directions. The scale for volume of liquid collected was usually too small, therefore most candidates missed the second marking point. The line drawn on some graphs extended to the origin. This was a common mistake and meant that marking point four could not be awarded. The line should not be extrapolated beyond the first and last data points. Many candidates missed out plotting the value for 0.5%. Only occasionally were plots drawn that were bigger than one small square and most lines were carefully constructed and of an appropriate width.

(iii) The majority of candidates recognised that as the concentration of pectinase increased, the volume of liquid collected increased. For two marks, candidates should have noticed that the volume of liquid collected became constant at a concentration of 0.8% pectinase solution (or 0.92 cm^3 per g of chopped apple). Many candidates were awarded the first mark but did not add enough detail (data) for the second mark. Candidates need to consider the entirety of a graph when describing a relationship and ensure that their answers cover more than just an overall trend, especially if more than one mark is being awarded. As a general guideline, candidates should be encouraged to use relevant data quotes and to think about where these might be taken from the graph they have plotted.

BIOLOGY

Paper 0970/62
Alternative to Practical

Key messages

When drawing conclusions from an investigation, candidates should consider the aim of the investigation (which is usually stated in the information at the start of the practical). They should then give a conclusion linking the independent variable to the dependent variable.

When drawing graphs, candidates should not extrapolate their lines past the plotted data points.

General comments

Many candidates demonstrated good skills throughout the paper, including table drawing, graph drawing and biological specimen drawing.

Comments on specific questions

Question 1

(a) (i) Most candidates correctly stated the final volume of the solution.

(ii) Most candidates were able to draw a basic table. Headings proved challenging for some candidates, who either did not provide any units, stated incorrect units (such as cm^3 for acid concentration) or included units in the body of the table. Most provided data for both the acid concentration and the height of the yellow agar, although some did not complete the acid concentration with correct data or gave the value for the wrong agar.

(iii) Candidates should, when providing a conclusion, refer to the aim of the experiment given in the question rather than just repeating the information that was recorded as the dependent variable. In this case, the link between acid concentration and the rate of diffusion was required.

(iv) Many candidates were able to correctly identify the concentration of the acid as the independent variable, although some candidates did not specify concentration or incorrectly referred to acid volume. A common error was suggesting that the rate of diffusion was the dependent variable, rather than the height of the yellow agar. Some candidates gave imprecise answers, such as the amount of yellow agar produced, while others did not specify which colour agar was measured.

(v) Most candidates correctly recorded the temperature. A few gave a temperature of 20.3 °C.

(vi) Stronger responses identified that all the test-tubes had been equally affected by the temperature change as they had been placed in the same water-bath. Several candidates incorrectly suggested that the temperature remained the same during the experiment or that the experiment was not investigating the effect of temperature and so it was not relevant, or that temperature did not have any effect on the rate of diffusion.

(vii) Many candidates confused a control experiment with a controlled variable. Some candidates did realise that an experiment should be carried out using water, but only stronger candidates indicated that only water should be used and should replace the acid. A common incorrect answer was to suggest variables that should remain constant during the investigation, such as concentration of acid, time and type of agar.

(viii) Many correctly indicated that the height of the yellow agar would increase, although some did not specify the colour of the agar. A few candidates just said that the result would be different without saying how. Weaker responses only referred to a decrease in temperature rather than the effect on the results.

(b) (i) The majority of candidates successfully calculated the volume of the cube.

(ii) Graphs were generally well drawn and only rarely was volume used instead of length. A minority of candidates did not label the axes or missed out the correct units, and it was rare for the scale not to use the full grid. Some candidates ignored the idea of scale and randomly spaced the given values of time on the axis. Plotting was usually accurate. The most common graphical error was to extrapolate the line beyond the plots (often joining it to the origin) or a poorly drawn line which was sketchy or too thick.

(iii) This question was generally answered well with most candidates clearly indicating on their graph how they estimated the value for a 3 mm length. It was clear that some candidates had calculated the value for 3 mm rather than read it from their plotted graph, giving an answer which was then incorrect.

(iv) Most candidates answered this question well. The most common variables suggested were temperature and acid concentration. The most common incorrect answers were time or size or volume of the cube, which suggested that some candidates were not answering from the context of the question or identifying the dependent and independent variables. Some candidates gave imprecise answers such as 'the acid' or 'the agar' without stipulating any parameter such as concentration or type.

Question 2

(a) (i) The drawing was well done by most candidates, although some drew outlines that were broken and some included shading. Some candidates did not correctly draw the 'curly leaves' of the shoot.

(ii) Many candidates demonstrated good mathematical skills and performed the calculation well to achieve maximum marks. Some candidates did not read the question fully and provided answers to more than two significant figures. Some candidates measured in centimetres rather than millimetres, or also included units of measurement in their answer such as mm, which is incorrect for magnification.

(iii) This question assessed observational skills and most candidates were able to recognise at least some similarities and differences between the two seedlings. Weaker responses mentioned a feature but did not specify which example it referred to.

(b) The majority of candidates gained full marks for this question. Some candidates did not mention the need for heat when testing with Benedict's solution. Some candidates confused Benedict's solution with biuret solution. A few candidates suggested decolourising the seedling (using ethanol) prior to using the iodine solution test for starch, as if they were testing a green leaf.

(c) Many candidates gave well planned, detailed responses, demonstrating an awareness of what to include in a plan. Most candidates suggested using at least two different light intensities, although some then gave no indication as to how this might be achieved. A significant number of candidates misread the question and changed the angle of lighting incident on the seedlings rather than changing the light intensity or changed the direction of light shining on the seedlings. Most candidates gave at least two examples of controlled variables, but some candidates made imprecise suggestions such as 'use the same supply of water', 'use similar seedlings', or 'leave for 2 to 3 days. Stronger responses described the use of a heat shield and measuring the angle with a protractor. Most candidates clearly stated that an experiment should be repeated at least twice. Several did not include safety aspects, or lacked detail on how they were relevant to their plan, such as not handling very hot lamps, or wearing gloves to avoid touching plants with possible allergens. A few misunderstood the question and wrote theoretical answers about plant tropism or photosynthesis.