BIOLOGY

Paper 0970/11
Multiple Choice (Core)

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

General comments

There was a good understanding of the binomial naming system, specialised cells for oxygen transport, food tests, the effects of pH on enzyme activity, pancreatic hormones, HIV transmission and the characteristics of bacteria that make them useful for biotechnology.

Candidates should be able to use descriptions of terms in the syllabus such as egestion, artery, vein, sexual reproduction, and biodiversity.

Candidates need to read all of the information provide to ensure they are answering the question asked (for example **Question 1**, **7**, **9** and **29**) and interpret diagrams carefully (such as in **Question 19** and **25**).

Comments on specific questions

Question 3

Many candidates incorrectly selected option **B**. Candidates are expected to know the characteristics used to classify the main groups of vertebrates.

Question 7

While many candidates selected the correct answer, option **A** was a common incorrect response. So although many new the correct substance fewer understood the direction of movement of molecules during diffusion.

Question 8

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Many candidates chose option **C**. Candidates should be familiar with this type of investigation and understand that water will move out of the potato when it is in a very concentrated sugar solution causing a loss of mass.

Question 19

Many candidates correctly selected the renal vein as the correctly labelled vessel, but a similar number incorrectly thought the pulmonary artery label was correct. This vessel was the pulmonary vein.

Question 21

Many candidates knew the requirements for germination, but some thought that this required photosynthesis rather than respiration and selected option **B**.

Question 25

Most candidates could identify the relay and sensory neurones from the diagram.

Question 33

This proved to be challenging with only a few candidates correctly applying their knowledge of variation to this novel context.

Question 35

Many candidates could correctly apply the principles of adaptive features to this example.

Question 39

Some candidates incorrectly thought that reducing biodiversity would conserve endangered species.

BIOLOGY

Paper 0970/12
Multiple Choice (Core)

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

General comments

There was a good understanding of the role of magnesium ions, disease prevention, the role of testosterone in the development of secondary sexual characteristics and how to interpret bar graphs.

Candidates should be able to recall descriptions of terms in the syllabus such as continuous variation, genotype, and osmosis.

Candidates need to read all of the information provide to ensure they are answering the question asked (for example **Question 21** and **28**) and interpret graphs precisely (such as in **Question 39**).

Comments on specific questions

Question 5

Some candidates were able to order the specimens from smallest to largest. It is important to read the question carefully as the most common incorrect answer was from largest to smallest.

Question 6

Many candidates did not realise that osmosis must refer to the movement of water molecules.

Question 7

Some candidates were unclear about the synthesis of large molecules. Common errors were that amino acids make up carbohydrates or fatty acids make up glycogen.

Question 14

Many candidates did not know where amylase acts with many choosing the stomach or the pancreas.

Question 15

The roles of the small intestine and the colon in absorption were not well understood with few choosing option **D**.

Question 16

Many candidates did not realise that the space shown in the leaf diagram contained air and so arrow 1 represents evaporation rather than osmosis and arrow 2 shows diffusion of water vapour and not evaporation.

Question 30

Some candidates could correctly work out the probability of a child having cystic fibrosis, but a similar number thought this was 50%. Candidates should carefully work through the information given in the question.

Question 36

Candidates seemed unfamiliar with the sigmoidal growth curve with most choosing the exponential (log) or stationary phase instead of the lag phase.

BIOLOGY

> **Paper 0970/21**
> **Multiple Choice (Extended)**

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

General comments

There was a good understanding of cell structure, the complementary base pairs in DNA, the structure of a synapse, phototropism, and antibiotics.

Candidates are expected to be able to recall key terms in the syllabus such as biodiversity and assimilation.

Candidates need to read all of the information provide to ensure they are answering the question asked (for example **Question 1**, **36** and **40**) and interpret diagrams carefully (such as in **Question 18**, **28** and **35**).

Comments on specific questions

Question 1

Many candidates could not link the need for carbon dioxide to photosynthesis and nutrition. Instead, many candidates selected respiration.

Question 7

The majority of candidates interpreted the enzyme activity graph correctly, but some thought that heat had 'killed' the enzyme.

Question 10

Many candidates thought this described absorption rather than assimilation.

Question 17

There was some confusion about the direction of water movement from the blood into the gut.

Question 18

This was a challenging question with only a few candidates selecting the correct description for what is happening at X.

Question 23

Many candidates could identify the endocrine gland and the effect of a hormone it releases, although some thought that the hormone reduces blood glucose concentration.

Question 34

Most candidates selected incorrect statements about a pyramid of energy. Many thought that they show how energy is lost.

Question 35

Although many candidates could interpret the food web correctly, some did not realise that there are four secondary consumers. Candidates should be reminded to look at the arrows showing energy transfer rather than the position of organism name on the page.

Question 36

Many candidates could interpret this investigation correctly, but some did not have a clear understanding of the different roles of the bacteria in the nitrogen cycle.

Question 38

A large number of candidates confused the description of biodiversity with ecosystem.

Question 40

Most candidates answered this correctly, but a significant number thought that the expression of the human insulin gene in bacteria was a starting point rather than the desired outcome.

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Paper 0970/22
Multiple Choice (Extended)

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

General comments

There was a good understanding of enzymes, leaf structure, microvilli, heart structure, and xerophytes.

Candidates should be able to recall descriptions of terms in the syllabus such as limiting factors, gravitropism, and phototropism.

Candidates need to read all of the information provide to ensure they are answering the question asked `(for example **Question 7**, **26** and **35**) and interpret diagrams and graphs carefully (such as **Question 9**, **15** and **22**).

Comments on specific questions

Question 3

Few candidates could identify the organism as a protoctist.

Question 7

Some candidates did not understand the direction of water movement in this context and so incorrectly chose option **B**.

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Question 9

Many candidates incorrectly thought that light intensity was acting as a limiting factor at position 4. This highlights a common misconception when interpreting graphs showing the rate of photosynthesis to identify limiting factors.

Question 14

The majority of candidates knew that xylem vessels do not contain any mitochondria but some thought that the xylem vessels have thin walls.

Question 22

While many candidates recalled the correct type of respiration fewer selected the correct molecule with option **B** being the commonest incorrect response.

Question 26

Most candidates did not use all the information in the question. The seedling is underground and so it cannot be responding to light. This led many candidates to select option **B**.

Question 28

The majority of candidates knew that the offspring produced in asexual reproduction are genetically identical but some thought that asexual reproduction involved the fusion of gamete nuclei.

Question 31

Some candidates thought that the pedigree diagram showed a condition caused by recessive alleles. It is important to work through the diagram. If the condition was caused by recessive alleles there would not be an unaffected individual in the third generation.

Question 36

Candidates should read the question carefully. The majority of candidates could correctly identify the pyramid of energy, but fewer could identify the pyramid of numbers for this food chain.

BIOLOGY

> **Paper 0970/31**
> **Theory (Core)**

Key messages

Candidates should read questions carefully, as they often contain specific information that must be used in the answer. For example, when the question asks for two lines to join boxes, only two lines should be drawn.

It is important that candidates write clearly and spell scientific terms correctly.

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 enables candidates to express themselves more clearly.

Comments on specific questions

Question 1

(a)   Most candidates gain full marks here although some named cells rather than stating the appropriate letter. Letters **A** and **D** were often swapped around.

(b)(i)   Most knew the nucleus contains genetic information and/or DNA. Although most knew the correct answer some missed marks by poorly expressing themselves or by adding incorrect information, such as the nucleus controlling what enters and leaves the cell or storing nutrients for example.

(ii)   Most were awarded at least one mark, usually for cytoplasm or cell membrane. Incorrect answers included cell walls and chloroplasts.

(c)   Surface area and absorption were the most common correct answers. Some candidates struggled to describe the extension, and some called it a hair or cilia. Most knew it took in water and minerals but did not use the appropriate term; absorbed.

(d)   This question was not well answered. Many stated inappropriate equipment such as a ruler.

Question 2

(a)   Few candidates knew that carbon dioxide is a raw material. Most managed to name oxygen as the gas produced during photosynthesis. Although many gave the correct term, intensity was not well-known.

(b)   There was some confusion over the green pigment. Some candidates thought it produced chlorophyll, some thought it was found in chlorophyll, and some were confused between chlorophyll and chloroplasts. Many candidates could relate the presence of the green pigment as an indicator of a healthy plant and often stated that if it was absent, the plant would be brown or unhealthy. There was some imprecise scientific language regarding the green pigment. Absorbing light energy, attracting it and using it were commonly seen. Few referred to an energy transfer. Most knew of its importance in photosynthesis which helped them suggest glucose as a product.

(c)   There was some confusion between respiration and photosynthesis.

Question 3

(a) Most candidates were able to gain at least one mark on this question, although few recognised that words in the list could be used more than once even though it was stated in the question. Most gained marks for identifying the stomach as the organ where physical digestion takes place and that the pancreas secretes insulin. A few candidates referred to pancrease instead of pancreas.

(b) The majority of candidates were able to gain one of the two marks available, mainly by stating that hydrochloric acid kills microorganisms although some answers referred to the acid protecting against pathogens but not stating how. Few candidates were able to state that hydrochloric acid provides a suitable pH for enzymes. Many incorrectly referred to the acid digesting or breaking down food.

(c) Many candidates scored well on this question. They could correctly state that protease was an enzyme that digested protein into amino acids. Few candidates referred to the absorption of the amino acids. Marks were often missed because of poor expression. A few candidates referred to protease building proteins.

(d) (i) Some candidates were able to score both marks on this question. Some candidates did not describe the colour in test-tube Y as brown, instead stating red or yellow or orange. Brown was needed as a qualification to differentiate it from the results expected in a positive Benedict's reagent test. Some transposed the two answers.

(ii) Few candidates correctly identified that starch was digested by amylase. Most candidates just repeated what was in each test-tube.

Question 4

(a) A mixture of responses was seen here, with few being awarded full marks. Weaker responses gave a range of answers in the third gap, with taste, hearing and other senses stated.

(b) Many knew the role of the pupil. Most candidates realised that the amount of light had changed.

(c) (i) Candidates should be careful when labelling diagrams. 'X's were seen frequently on the fovea, lens and retina.

(ii) Many candidates were awarded full marks here. A few drew extra lines.

Question 5

(a) (i) Candidates showed the ability to interpret the table correctly and many obtained full marks. Those that did not often gave more than three ticks.

(ii) The majority of candidates were able to correctly identify osmosis, many referred to diffusion which was acceptable. Incorrect answers included absorption, transpiration and active transport.

(iii) Temperature was the commonest answer but very few went on to gain the second mark. Many referred to pH, time, mass, distance or size of the membrane.

(b) This question was generally well answered although a few incorrectly stated cell membrane or vacuole rather than cell wall.

(c) (i) Many candidates were awarded full marks here. Common errors were phagocytosis and enzyme.

(ii) Most candidates correctly answered this question. A few candidates confused a balanced diet with a healthy lifestyle and so commented on eating enough vegetables, going to bed early and having enough exercise.

Question 6

(a) (i) Few could relate the description of the blood vessels to the table. Some merely circled **X**, **Y** or **Z**.

(ii) The majority did not realise that the structure was a valve. Many described arteries as having a thick wall or carrying oxygenated blood and many just named a blood vessel.

(b)   Many got the heart and lungs backwards. Few named the aorta or the renal vein.

(c)   Many candidates were awarded one mark for stating urea or water. Incorrect answers included urine, faeces and semen.

(d)   Most knew at least one system and many knew two.

Question 7

(a) (i)   The majority could not convert cm to mm – answers ranged from 5000 to 50.

(ii)   A few got the types of plastic the wrong way round. Some stated that macroplastics and microplastics were present from the start, or 1960. Many got the mark for macroplastics increasing, but they found it difficult to express the change in microplastics correctly with the appropriate years. Several only got half the story and did not make relevant comparisons. Many did not make correct data quotes and gave general figures rather than accurate figures. A mark was often missed because no units, or incorrect units, were given. A common error was stating that the microplastics peaked in 2010 rather than 2000.

(b)   Most candidates gave at least one correct answer, usually about eating the plastics or getting tangled. Some described damage to the ecosystem, or toxin release rather than damage to the individual animal. Frequently the idea of blocking out sunlight leading to eutrophication was mentioned.

(c)   Most gave a correct answer, usually oil or sewage. Some incorrectly mentioned air pollution. Those that did not gain this mark gave answer such as waste, paper and metal. Others used the opportunity to write down what they had learned about pollution in general and so mentioned carbon dioxide, burning, and deforestation.

Question 8

(a)   This was a well-known topic. Occasionally a mark was missed because the candidate gave reproduction as an answer which was given in the question.

(b) (i)   Most candidates named the egg cell correctly, but ovules, ovaries and sperm were also seen. There was some confusion between the terms ovum and ovule.

(ii)   Fertilisation was sometimes described as fusion but was generally well recognised. Some responses incorrectly referred to implantation.

(iii)   Many candidates gained this mark, mostly for zygote but occasionally for fertilised egg cell. Some candidates were confused between zygote, embryo and foetus.

(iv)   All stage numbers were given as answers but stages 3 and 5 were the most common incorrect answers.

(c) (i)   Many candidates were awarded at least one mark here with **X**, placenta, less well known than **Y**, umbilical cord. **X** was often identified as nerves or blood vessels.

(ii)   Many candidates were awarded the mark, though some were too vague; such as keeping the baby safe. Also, many seem to think that the amniotic fluid provides nutrients and allows the baby to breathe.

BIOLOGY

Paper 0970/32
Theory (Core)

Key messages

Candidates should read the whole question and their answer carefully before moving on. They should ask themselves if they have answered the actual question. The information they have given may be factually correct but does not directly answer the question.

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 enables candidates to express themselves more clearly.

Comments on specific questions

Question 1

(a) (i)   This question needed careful reading as it asked for the structure in a plant cell not the tissue.

    (ii)   Many candidates gave the structure where chlorophyll is found rather than naming chlorophyll.

(b) (i)   A few candidates confused the unit for the side of a square (cm) and the area (cm^2).

    (ii)   This question was looking for the link between the amount of light and surface area as an adaptation.

(c) (i)   Candidates needed to look very carefully at the leaf cross-section and at the different tissues. The shape of the cell should help identify the cell. The end point of each line is important, as epidermis and spongy mesophyll are close together. The line for **D** labels the cuticle, not the epidermis.

    (ii)   Many correctly named the xylem and phloem.

(d) (i)   Candidates should take notice of the description of images and diagrams. If it is a picture of a leaf, then answers about skin or blood are not suitable. Few candidates identified the guard cell.

    (ii)   Good attempts were made to describe how this cell adapts the leaf for photosynthesis. Some candidates confused which gases were entering or leaving the stomata.

Question 2

(a)   Many candidates selected the correct conclusions.

(b) (i)   Although most candidates understood that the seed needed water for germination, many thought the seed would be photosynthesising so gave carbon dioxide as a requirement. Many confused growth with germination.

    (ii)   Candidates predicted that the seed would still germinate, but did not notice that the higher, optimal temperature would result in faster germination. The first investigation was at 10 °C, so germination at the middle of the range of temperature should be faster.

(c)   A well answered question. A few candidates gave 'photo trophic' in error, rather than phototropic. Better responses described the plant root growing into the soil or towards gravity or the centre of the

Earth. A common error was to state that plants grow on the ground which was not sufficiently clear for the mark to be awarded.

Question 3

(a) Candidates need to be careful with their description of an acid. Whereas highly acidic is correct, high pH describes an alkali.

(b)(i) Most candidates calculated the percentage correctly.

(ii) It was important to select the contaminated water section for the calculation. A few candidates used their own calculation from **3(b)(i)**.

(c) Candidates showed a good understanding of hygiene and prevention of infection.

(d) Most candidates gave correct answers. Body defence means defence by the body, not how we can protect the body.

(e) This proved to be a challenging question as most candidates did not recognise it as a bacterial cell, but as a plant cell.

Question 4

(a) Most candidates correctly drew four straight lines.

(b)(i) Few candidates knew which food items are high in iron.

(ii) The question asked for the roles of blood clotting. Some candidates described how blood clots or how blood travels around the body.

(c) Few candidates identified the aorta.

Question 5

(a) Most candidates identified the ribs and diaphragm but not the intercostal muscle.

(b)(i) Candidates need to be careful with naming parts, some confused bronchi with bronchioles.

(ii) Candidates need to understand the different parts of the breathing system and how they are connected.

(c)(i) Candidates were asked to identify the direction of carbon dioxide movement. Many candidates selected arrows for oxygen.

(ii) A few candidates described how gases are exchanged, rather than the features of the alveoli that enable efficient gas exchange.

(d)(i) Most knew the word equation for aerobic respiration.

(ii) Many candidates misread the question and gave a type of cell, rather than a structure within a cell.

Question 6

(a) This question was generally well answered. A common error was to give net rather than random movement of molecules.

(b)(i) Many candidates gave examples of molecules rather than the three elements.

(ii) Few candidates gave suitable molecules.

(c)(i) Many candidates did not recognise the corresponding parts of the model cell.

(ii) This proved to be a challenging question with only a few realising that starch was a large molecule that would be too large to move through the membrane. It was important to look carefully at the diagram to find the location of the water and the mixture.

(d) Most candidates correctly identified the enzyme.

Question 7

(a) (i) The scientific name for elephant was given above the photograph. Most candidates selected the correct genus. A few gave the species name.

(ii) Most answered correctly, although a few gave features that were not visible.

(b) (i) Nearly all candidates selected the bearded pig from the food web, as they could clearly see the lines from the pig to the stick insect and the jackfruit tree.

(ii) Most candidates correctly identified a tertiary consumer.

(iii) Most candidates correctly identified a producer.

(iv) Most candidates knew that insects are arthropods.

(v) Most candidates were able to construct a food chain using organisms from the food web. Very few gave a chain using other animals.

(vi) Most answers were descriptions of a food web rather than an ecosystem.

(c) Most candidates were able give a number of correct answers by selecting data from the graph.

(d) Many excellent answers were seen that showed a wide range of reasons why elephants become endangered.

BIOLOGY

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Paper 0970/41
Theory (Extended)

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Key messages

Candidates should read all stimulus material carefully and follow all the instructions contained in the question. Vital information was present in **Questions 1(a)(ii)**, **1(b)(ii)**, **2(a)**, and **5(a)**, and this was often missed by some candidates.

It would be beneficial for candidates to practice the spelling of keywords, particularly in cases where they could be confused with another keyword. The spelling of ureter was important in **Question 4(c)**, and the spelling of phototropism was important in **Question 6(a)(iii)**.

Learning definitions and descriptions of terms in the syllabus is important for answering questions directly as well as providing scaffolding for longer prose questions. Knowing the meaning of the term population was important for **Question 1(b)(i)** and the meaning of the term excretion for **Question 4(a)**.

General comments

A high standard of scientific knowledge and understanding was evident, with many candidates providing detailed and accurate responses. On occasion, some responses were lacking in detail. Candidates can use the mark allocation of the question as a guide to how many specific points they need to make in their responses.

While many candidates had a broad knowledge of the syllabus, it was evident that some areas of the syllabus were better known than others. For general guidance, the syllabus can be used as a guide to what content needs to be covered and can provide an excellent revision tool for candidates.

Comments on specific questions

Question 1

(a) (i) The correct response of Sun was frequently seen. Alternatives including sunlight and light were also accepted. Inaccurate responses such as photosynthesis were not credited.

(ii) Some candidates calculated the percentage of energy lost rather than the percentage of energy transferred. The question also asked candidates to express their answer to one significant figure. A few candidates incorrectly rounded their answer.

(iii) The reasons for energy loss between the trophic levels were generally well known. A common misconception was to state that energy is used in respiration rather than released by respiration.

(iv) This question was demanding. Some candidates were able to suggest that pyramids of energy take into account the different sizes of organisms, or that it is a more accurate representation of energy transfer. Few candidates suggested that pyramids of energy take into account the rate of reproduction, life spans or time.

(b) (i) The meaning of the term population was generally well known. Alternative words were accepted for area.

(ii) A common issue for some candidates was that they only described and explained the initial rise of the graph and therefore were only able to access some of the available marks. Some candidates also attempted to describe the whole graph, which was unnecessary, although these candidates

were not penalised for this. The best responses described the change in the rate of increase of the population.

Question 2

(a)   This question asked for the differences in distribution of rod and cone cells and not the number. Any references to numerical values were ignored. Candidates were generally able to identify the peak of cone cells at the fovea and the absence of rod cells. Identifying the peak of rod cells was more challenging. Some candidates were able to describe the uniform distribution of cone cells outside the fovea.

(b)   Some candidates suggested that nocturnal animals have more receptor cells in general. However, this question required more detail and answers needed to specifically explain in terms of rod cells or cone cells.

(c) (i)   Most candidates gave the correct name for this reflex. Responses such as reflex action, involuntary action, or iris reflex were not credited.

(ii)   Effectors are always muscles or glands. In this case, the effector was the circular muscle. Incorrect responses included radial muscle and ciliary muscle. Very occasionally, candidates omitted the term muscle, which was necessary to be creditworthy.

(iii)   The correct response of antagonistic was commonly seen. Involuntary was also an acceptable alternative.

(d) (i)   The parts involved when an impulse is transmitted across a synapse were generally completed well. A common misconception was to refer to the receptor protein as a receptor cell.

(ii)   The process of diffusion was commonly seen, as was the process of movement from an area of higher concentration to an area of lower concentration. Very occasionally, incorrect processes were seen, such as osmosis and active transport.

Question 3

(a) (i)   There was some confusion with identifying structure **X**. Incorrect responses included style and pollen tubule.

(ii)   A number of misconceptions and inaccuracies were evident. A common misconception was that it is the pollen grain that travels down the pollen tube. Another misconception is that the name of the structures in the ovary are ova rather than ovules. The best responses described the movement of the pollen nucleus and the subsequent fusion with the nucleus of the ovule.

(b) (i)   Some candidates confused the effects of self-pollination with the reasons why it may happen. Other candidates suggested the advantages of self-pollination compared to cross-pollination, which is slightly different to the question asked. Candidates should be reminded to read questions carefully and answer the question that is asked.

(ii)   This question was generally answered well, with many candidates being able to suggest a number of consequences of using only self-pollination.

(c)   Several sources of genetic variation in populations were stated. Vague responses such as sexual reproduction were not credited.

(d)   The roles of mitosis were generally described more successfully than the actual process. Few candidates referred to the separation of chromosomes or nuclear division.

(e)   The correct response of stem cells was commonly seen.

Question 4

(a)   Descriptions of key terms are included in the syllabus and candidates should use them as a guide to their learning. Some candidates referred vaguely to waste products rather than metabolic waste

products. Some candidates referred to toxic products in excess, which is inaccurate as all toxic material is in excess by definition.

(b)   The correct response of carbon dioxide was commonly seen. Water vapour was also an acceptable response.

(c)   The cortex and medulla were frequently confused. The spelling of ureter was important due to the possible confusion with urethra.

(d)   There were some excellent responses seen, with the names of the fluids identified and the differences in their composition described and explained. Occasionally, it was clear that some candidates confused urea and urine.

(e)   Some candidates were able to give a correct response of deamination. Fewer were able to state or describe assimilation or protein synthesis.

Question 5

(a) (i)   Many suitable responses were seen. Occasionally, candidates were too vague, referring to ears unqualified rather than external ears. Features that were possessed by other groups including tail, and limbs were not credited.

(ii)   Candidates should have read all the information given to them in the stimulus material carefully. The groups with the most common recent ancestor would be the groups that split the latest in time, which would be the apes and rodents. Several candidates gave sharks and bony fish due to their physical similarities, and others gave crocodiles and birds.

(iii)   There was some confusion evident amongst candidates. Some tried to give two groups for each line. A small number of candidates mistakenly reversed the answers, giving sharks as the most similar and birds as the least similar.

(b)   The descriptions of DNA were generally accurate and detailed, with many candidates giving creditworthy responses.

(c)   This was a demanding question. There was some confusion between the formation of mRNA and protein synthesis. Many candidates were able to describe simply that proteins or protein production was responsible for different cell functions. Only the more able candidates were able to refer to sequences of amino acids and their effect on protein shape.

Question 6

(a) (i)   It was important for candidates to read the stimulus material carefully to identify that this investigation was conducted with light from every direction, and so the direction of light was not a factor in the investigation. Candidates that recognised the effect was due to gravity generally answered this question well.

(ii)   Most candidates identified that roots would grow down towards gravity.

(iii)   Most candidates were able to name the response as phototropism. Spelling of phototropism was important, and candidates should be reminded to spell keywords correctly.

(b)   There were some excellent responses seen with detailed and accurate descriptions. Very occasionally, candidates confused turgid and flaccid. Some candidates included the description of osmosis, which although correct, was irrelevant to this question.

BIOLOGY

Key messages

Candidates need to read questions and the additional information on diagrams and keys, carefully. For example, they should check how many significant figures to use in their answer, or the suggested key to use for alleles in a genetic cross.

Candidates need to read through their answers carefully and in particular, check for contradictions.

Candidates need to gain confidence when using the correct biological terminology so that they can add detail to their answers.

Candidates are reminded to show all their working in calculations.

General comments

There was generally good subject knowledge on the human gas exchange system, **Question 1(a)**, the immune system, **Question 2**, and genetic modification, **Question 3(b)**. However, in some cases key terminology was used incorrectly or the sequence of events was confused.

Misreading of command words, instructions or information in questions led some candidates to give incorrect answers. For example, many candidates gave explanations, rather than descriptions in their answers to **Question 4(b)** and **Question 6(a)**. Other candidates did not give answers to the correct numbers of significant figures, **Question 3(a)**, or gave the name of a disease rather than a pathogen, **Question 2(b)(i)**. It was also not uncommon to find long answer responses with contradictions suggesting that these candidates had not reread their answers. Other candidates seemed to be recalling the answers to questions in previous papers, rather than using the information provided in this question paper. This was particularly noticeable in the genetic cross, **Question 1(c)**.

Question 1

(a) (i)   Most candidates knew the names of the three labelled structures in the human gas exchange system. Although phonetic spellings were credited, some words were illegible or a hybrid of two terms and could not be accepted. The most common error was to label the bronchioles as the alveoli.

(ii)   Many candidates recalled that the cartilage in the gas exchange system is to keep the airway open. However, some candidates gave vague answers about support or protection without providing sufficient context.

(iii)   Inspiration was well described by most candidates but only the most comprehensive answers mentioned that the air drawn in equalises the air pressure between the lungs and the atmosphere. Almost all candidates knew the mechanisms that increase the volume of the thorax and decrease the pressure although there were some responses where it was suggested that the change in volume and pressure of the thorax caused the change in the position of the ribs and diaphragm. It was also quite common to see contradictory statements such as the diaphragm contracts and rises or vague answers about intercostal muscles without stipulating that it was the external intercostal muscles that contract.

(b) (i)   The goblet cells and ciliated epithelial cells were the most common cell types described and explained. A few candidates confused the terms ciliated and ciliary, and many described the cilia as moving pathogens and particles directly, without any reference to the idea that they would be in the

mucus. Others described the movement of the cilia but did not mention the direction of travel or were vague about the specific roles of the goblet cells and the ciliated epithelial cells. Other candidates mentioned lymphocytes and phagocytes but then gave vague answers about the function of white blood cells.

(ii) Almost all candidates realised that the thicker and stickier mucus would block the airway, though many candidates gave vague responses about difficulty in breathing or affecting the airway. Those candidates who went on to explain the impact on the ability of the person to do exercise often gained full credit. The most common points were to describe that less oxygen would be delivered and that this would result in less aerobic respiration. Very few candidates explained the reason for reduced gas exchange.

(c) Many candidates knew the genotypes for heterozygous parents and completed the genetic diagram to predict the probability of them having a child with cystic fibrosis. Some candidates either did not know what symbols to use for the gametes or switched to a different set of symbols halfway through their answer. This meant that these candidates did not gain full credit. Another common error was to wrongly attribute the alleles to the X chromosome and predict the outcome from a sex-linked genotype. This error was seen frequently and suggests that these candidates had not read the question carefully.

Question 2

(a) Almost all candidates correctly identified the red blood cell in the photomicrograph and many also correctly stated its function. A few candidates described that it would contain haemoglobin or was biconcave in shape, rather than giving its function. Although most candidates could correctly link the lymphocyte and phagocyte to their functions, many switched the correct label letter for these two cells. A few candidates labelled them as white blood cells, which was too vague. A number of candidates thought that label **H** was cytoplasm, rather than plasma and many descriptions of it being a fluid were seen, rather than a statement about its function. Almost all candidates knew the function of platelets in blood clotting.

(b)(i) Many candidates stated that HIV is transmitted with direct contact with blood. It was rare to see candidates state AIDS, without qualifying that it was the virus that is transmitted. A few candidates named other correct blood-borne pathogens such as the hepatitis virus, and even though this is knowledge beyond the syllabus, these were also credited. Vague responses such as virus or bacteria were not credited.

(ii) The full range of possible ways in which pathogens can be transmitted incorrectly were seen. The most common errors were to describe direct touching between individuals or to mention the use of a utensil without making it clear that it was contaminated or had been previously used by someone else.

(c) The role of antibodies was well known by many candidates. A common error was to mix up the terms antibody and antigen. A misconception was to describe the antibodies as engulfing pathogens, rather than marking the pathogens for engulfing by phagocytes.

(d) Many candidates knew one or two differences between active and passive immunity, but few gave three differences. A common vague statement was to state that passive immunity was passed from a mother to an infant through breastmilk without any mention that it is antibodies that are transferred. A few candidates confused the body defences with passive immunity.

Question 3

(a) Almost all candidates read the correct values from the graph, and many went on to do the correct calculation and give their answer to two significant figures. Common errors were to use the wrong denominator or to round the calculated value incorrectly.

(b)(i) Many candidates knew that DNA is the biological molecule where genes are found, but common incorrect answers were nucleus, chromosome, proteins and amino acids.

(ii) Only those candidates who read the question carefully realised that this was not about selective breeding, but rather a process to check the inheritance of the gene, the quality and safety of the crop,

and to produce enough GM plants. Many candidates incorrectly described the genetic modification as a mutation.

(iii) Many very comprehensive descriptions of how a gene can be transferred from one organism to another were seen. Even those candidates who were less sure of some of the details could describe one or two steps in the process, but these were only credited if they were written in the correct context. For example, some candidates described the sticky ends on proteins, or the insertion of one plasmid into another plasmid. Common errors were to mix up the two enzymes, or to describe cutting the gene into pieces, rather than cutting the whole gene from a piece of DNA.

(c) (i) Almost all candidates gave sensible suggestions of how to prevent pollination between a GM crop and wild plants. Some impractical and destructive suggestions such as killing all the wild plants were seen but not credited. A few candidates described placing a covering over the stigma, rather than the anther.

(ii) Increasing yield was the most common advantage of GM crops that was given. Many candidates also knew other examples such as improving the nutritional value or conferring resistance to factors other than insects. A common error was to describe this as an immunity rather than a resistance.

Question 4

(a) Many candidates knew part of the description of an adaptive feature, but few very know all the correct terms. The most well-known term was survive, but many of these candidates did not recall the idea that they must also be able to reproduce and hence did not gain credit.

(b) Many candidates gave clear descriptions of the features of the marram grass leaf that showed it was a xerophytic plant. Common correct answers included a thick cuticle and the presence of hairs. Some candidates incorrectly identified these as root hair cells or gave features that were not specific to the leaf in the photomicrograph. Others did use the image but incorrectly thought that the rolled inner surface of the leaf made a large air space.

(c) (i) Most could convert the measurement from micrometres to millimetres. It was quite common for the answer to be expressed in standard form, although this was not a requirement for the mark. A few candidates misread the instruction and rounded the number rather than converting it to the new units.

(ii) Almost all candidates knew that cellulose builds cell walls. The most common incorrect answers were starch, glucose and lignin.

(iii) Although most candidates did give correct features of xerophytic stems, it was not uncommon for candidates to describe features of leaves or roots instead. Other candidates gave features to prevent herbivory, such as spikes, rather than adaptations for dry environments.

(d) Most candidates could correctly describe the two root systems, and many also gave a suggestion about how they were adapted for living in dry environments. A few candidates incorrectly thought that the roots extending close to the surface were not adapted to dry environments. A few candidates focused on the absorption of nutrients or anchorage rather than the uptake of water.

Question 5

(a) (i) Many candidates knew that nitrate ions were transported into the root hair cell by active transport, with only a few suggesting diffusion or osmosis. Candidates often correctly referred to the difference in concentration outside and inside the cell although a small number of candidates then went on to contradict themselves by stating the ion moved down a concentration gradient. A few candidates also confused the mitochondria for chloroplasts, but those that did correctly identify them often went on to explain their role in providing energy.

(ii) Many candidates knew one of the methods by which nitrogen is fixed, but only a few candidates gave two correct ways. Some candidates incorrectly suggested that nitrifying bacteria are involved or mentioned root nodules without any reference to bacteria.

(b) Almost all candidates knew that water moves by osmosis into the root hair cells.

(c) Many candidates correctly described some differences and similarities between a root hair cell and a bacterial cell, and it was rare to see answers that considered only similarities or only differences. Very few candidates mentioned that cytoplasm is found in both cell types, but many knew that only root hair cells have a nucleus. Common incorrect comparisons included suggestions that only root hair cells have cell walls, or that both cell types contain vacuoles or other membrane-bound organelles. A few candidates contradicted themselves by giving the same cell structure as both a similarity and a difference.

Question 6

(a) There were some very good descriptions of the results of the investigation of how much jelly was digested by two enzymes at different pH values. Many candidates identified the two peaks and also referred to the pH values where no jelly was digested. Most candidates who quoted appropriate data points included the units, but some candidates did not read the question carefully and mentioned optimum temperatures or offered explanations even though this was not required.

(b) Many candidates looked at the correct trend line and stated that there was no enzyme activity. However, some candidates did not refer to denaturation caused by the low pH, often opting to explain other parts of the graph, or incorrectly discussing temperature. Other candidates misread the key or the question and referred to enzyme **L** instead of enzyme **M**. Others introduced contradictions into their answers by using incorrect pH values.

(c) Most candidates correctly identified enzyme **L** as pepsin and also knew that it is located in the stomach. Some candidates suggested that the enzyme was a protease but did not qualify their answer to state which protease enzyme. The most common incorrect answer was trypsin, or a misspelt word that was a mix between 'trypsin' and 'pepsin'.

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 of 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

Candidates performed well on the paper with some good clear and concise answers. The production of good results for the diffusion practical and thorough answers when planning the osmosis investigation indicate a good level of practical skills for these candidates. The plotting of graphs and calculation of size also showed a good level of understanding.

When asked to draw a biological specimen it is important that candidates take their time and observe all features fully. Observation skills are an important aspect of practical biology.

Comments on specific questions

Question 1

(a) (i) Candidates were asked to investigate diffusion in agar blocks by putting them into different concentrations of acid. Most candidates were clearly able to perform the dilution of the hydrochloric acid and cut the blocks into suitable sizes. The results obtained were of a good standard, within the range expected for this investigation, and followed the expected trend for the concentrations of acid used. The most common error was giving the heading for the acid concentration as simply 'test-tube' rather than stating the actual concentration of acid and labelling it as such. Ideally a table should give sufficient information to understand the nature of the investigation. Another error was to record the time taken in minutes rather than in seconds. It is important that candidates read the instructions carefully before filling in their table of results.

(ii) Although a large number of candidates were able to state a valid conclusion for their results, many simply referred to the time taken rather than mentioning anything to do with diffusion itself. To construct a valid conclusion, candidates should go back to the stem of the question and use the underlying science behind any dependent variable measurement.

(iii) The majority of candidates were able to identify the independent and dependent variables, although often the rate of diffusion was stated instead of the time taken. Candidates must state the variable that was measured, rather than a calculated value.

(iv) The identification of sources of error in this investigation was answered very well, possibly due to actual difficulties encountered while carrying out the procedure. Difficulties caused by human error should be avoided; for example, incorrect reading of the stop-watch or other mistakes made while measuring. Sufficient detail should also be included, stating exactly what the source or error is rather than just saying 'the cubes' for example. Some candidates found it difficult to express the unevenness of the cubes as a potential source of error.

(v) Most could identify two safety hazards, but lack of detail was also an issue. Stating that the solutions were a hazard was insufficient as hydrochloric acid had to be identified. Some candidates described methods of reducing the hazard rather than the hazard itself, such as wearing gloves but not saying why this was being done. A few candidates only identified one hazard.

(b) For the planning question, candidates were asked to plan an investigation into the effect of temperature on osmosis in potato tissue. This is a familiar scenario, and most candidates did well on this question. It is important that candidates consider and describe suitable methods – such as drying the potato before measuring mass or submerging the tissue in a named solution. Safety aspects were described in suitable depth, but they must be relevant to the investigation, and ideally an explanation for any precautions should be included.

Question 2

(a) (i) The majority of candidates were able to identify the colour of DCPIP solution.

(ii) Many candidates found this question demanding and confused the concentration of vitamin C (which was the independent variable) with a controlled variable. Another common error was the lack of precision when describing the DCPIP solution. Stating that the 'amount' of DCPIP remained constant, could mean volume or concentration. Both of these needed to be described for both available marks.

(b) (i) Most candidates did well on this graph question. Ideally points should be plotted as small, neat crosses. The line must either be a line of best fit or a line that joins each plotted point. Extrapolation of the line was occasionally seen as well as lines that were feathery or far too thick. Care should also be given to ensure that the scale is linear and that plotted points cover more than half of the grid.

(ii) This question was answered well with most candidates using their graph to estimate the vitamin C concentration of the orange juice when 1.2 cm^3 of orange juice was used. The majority of candidates followed the instructions and indicated on their graph how they obtained their estimate.

(c) (i) Although many candidates stated a correct conclusion, a significant number tried to use each column to describe the trend, comparing sample 1 with sample 2 and sample 3.

(ii) When asked to define an anomalous result, most candidates were able to refer to a point not fitting in with the trend in the data. Simply describing an anomaly as 'different' was not sufficient as all of the results were different from one another to some extent. Candidates need to get across the idea of the anomaly being so different that it does not fit a trend in the data.

(iii) Most candidates circled the value of 96, presumably because it looks different from 104 and 170. It is important to look carefully at the actual values and work out the numerical difference between them.

(iv) Candidates were asked to calculate the percentage change in the vitamin C concentration. Many could do the calculation, but some candidates mixed up the values for the denominator. Candidates needed to show that they knew this was a percentage decrease by including a negative sign with their answer.

(d) (i) The drawing of a section through a strawberry was very well done with some good clear diagrams. The size was usually adequate, and all lines tended to be thin and unbroken. A few candidates did not include enough detail to gain both marks, particularly the detail of the inner section of the fruit. Some candidates incorrectly added shading or stippling.

(ii) The calculation of the actual diameter of the strawberry was particularly well done with full marks obtained my many candidates. The only issue was the distinction between significant figures and decimal places.

(e) Although most candidates were able to state that Benedict's reagent is used to test for reducing sugars, far fewer remembered that heating is required. Simply stating that the test-tube was placed in a water-bath is insufficient.

BIOLOGY

**Paper 0970/61
Alternative to Practical**

Key messages

It is important that candidates can confidently state the independent, dependent and controlled variables in an investigation. Candidates often find it challenging to describe the dependent variable.

When writing an investigation plan, candidates should describe the method step by step, rather than simply listing the independent, dependent and controlled variables, and providing a list of equipment needed. A detailed method will incorporate all of these and with enough detail to be awarded the marks.

Candidates need to pay attention to whether a calculation question asks to round to decimal places or significant figures, and to make sure they know the difference between these terms.

When drawing lines for a graph or drawing a specimen, candidates should use a freshly sharpened pencil as sometimes lines are too thick. Plot points should be drawn as a small cross.

General comments

It was evident that many candidates had a good level of practical experience as well as experience of tabulating their results and drawing graphs. Some excellent scripts were seen that scored very highly.

Candidates should ensure that they answer all questions and show their workings in calculations so that they may get partial credit if part of their calculation is incorrect.

Comments on specific questions

Question 1

(a) (i) The majority of candidates drew a table with columns for the concentration of acid and for the time taken for the agar to turn red. Most candidates converted the times on the stop-clocks into seconds as instructed. A common error was to give the heading for concentration as 'test-tube'. Candidates should have realised that the values in this column (0.4, 0.6, 0.8 and 1.0) were the concentrations of acid, and therefore this is what the column heading should be. Most included units for concentration and time, although some included units for time in the body of the table and some gave the unit for time as sec, rather than 's'. For those candidates who did not convert into seconds, they need to remember that the correct unit is minutes : seconds rather than just minutes. 'm' is incorrect as an abbreviation for minutes.

(ii) The start of the investigation stated that a student investigated the effect of concentration on diffusion. Therefore, the conclusion for the results should relate concentration to diffusion. In this case, that the rate of diffusion increases as concentration increases. Conclusions that only mentioned the time taken for the agar to turn red were insufficient.

(iii) Candidates had to state the independent and dependent variables in this investigation: concentration and time respectively. Occasionally these were given the opposite way round. Candidates found it more difficult to name the dependent variable than the independent variable. Instead, controlled variables were sometimes named, such as the type or size of agar block. Some gave the dependent variable as the volume of acid or distilled water, used to make up the different concentrations and some said it was the rate of diffusion. Some candidates restated the aim given at the start of the investigation as the independent variable, i.e. the effect of concentration on diffusion.

(iv) There were several different answers that candidates could describe to suggest improvements to the investigation. Many chose to point out that the investigation should be repeated multiple times and many also described the use of a colorimeter or colour standard to help determine the end-point when the agar had turned completely red. Others realised that only one syringe was used to make up the concentrations of acid and that they should use different syringes or clean them to avoid contamination. Some realised that it was important for the temperature to be kept constant.

Some responses lacked sufficient detail to get the mark. For instance, some described methods to measure the mass or size of the agar block but did not state that this was to ensure that they were all initially the same size. Others thought that the equipment used lacked precision and suggested other pieces of equipment, such as using a volumetric pipette rather than a syringe. Furthermore, some suggested ways to extend the investigation or speed up the investigation such as using smaller cubes of agar, or an increased range of acid concentrations. Candidates should know that repeating an investigation once is not enough and that it should be repeated at least twice.

(v) The main hazards in this investigation were the use of acid and cutting with a knife. Both had to be mentioned for the mark. Some did not follow the instruction and only gave one hazard. Many thought that the water-bath was a hazard. However, the method states that the temperature of the water-bath was warm, not hot, so this was not a danger. Other candidates described methods to reduce risk rather than the hazards themselves, e.g. wearing gloves or goggles.

(b) Candidates had to plan an investigation to determine the effect of temperature on osmosis in potato plant tissue. This is an investigation that all candidates should have completed in the classroom and one that they should be very familiar with. There were nine possible marking points, and many were able to describe a detailed investigation that was awarded full marks.

Those candidates that did not get many marks on this question often described expected results or theory in their plan. Some seemed to lack knowledge of osmosis and described growing potatoes rather than putting them into beakers or test-tubes of water or solutions. As with other questions, candidates sometimes struggled to describe the dependent variable adequately. Some omitted it completely or just said that the student should observe osmosis and did not realise that this needed to be measured in some way, such as by measuring the change in mass or length of the potato pieces. A number of candidates used the example of the first experiment in the paper and repeated the same method but used potato cubes, using dye or iodine to time how long it took for the colour to change.

Question 2

(a) (i) The majority of candidates knew that DCPIP is blue without vitamin C. Very occasionally, there was confusion with iodine solution and the answer blue-black was given.

(ii) This was an unfamiliar investigation to most candidates and there was some uncertainty as to which were the independent, the dependent and the controlled variables. Candidates should learn that in a table of results, the first column is the independent variable, and the second column is the dependent variable. Therefore, in this investigation concentration and volume of vitamin C were not the controlled variables. Naming these variables was a common mistake. Additionally, some candidates thought that the temperature was kept constant, but the method does not say this. Candidates should be clear when using the word 'amount' if they are meaning the volume or concentration. Those that gave the amount of DCPIP and concentration of DCPIP (or volume) as their answers were only awarded one mark.

(b) (i) Many candidates were able to demonstrate excellent graph drawing skills. There were many acceptable scales, as long as the data points covered at least half the grid in both directions and the scale was even. Some of the scales used on the *y*-axis for volume of vitamin C were too small. A common mistake was to give an uneven scale for the concentration of vitamin C. Some marked the number of squares between 125 and 250 as the same as between 250 and 500. Candidates are encouraged to choose sensible scales to make their plotting easier. For example, having 10 small squares for every 0.5 cm^3 of vitamin C rather than 10 small squares for every 0.6 cm^3 of vitamin C. Candidates are reminded not to extrapolate their line if they have joined the plots point-to-point and that a line of best fit should not be extrapolated off the grid. Some candidates did not label their axes correctly with the headings from the table.

(ii) This question was answered well with most candidates using their graph to estimate the vitamin C concentration of the orange juice when 1.2 cm^3 of orange juice was used. The majority of candidates followed the instructions and indicated on their graph how they obtained their estimate.

(c)(i) Most candidates stated that there is less vitamin C in stored apple juice than fresh apple juice. Some were looking for trends from sample 1 to sample 3 and thought that this showed a change in time, for example they said that the concentration of vitamin C in fresh juice decreased (over time). Some omitted crucial words such as vitamin C or fresh or stored.

(ii) This question was answered well, with many candidates clearly having learned the mark scheme for this question on previous exam papers. Many said that an anomalous result is one that does not follow the trend or pattern of the other results or is very different from the other results. Those that gave vague answers, such as an anomalous result is one that is inaccurate, wrong or an error, were not awarded the mark.

(iii) Many candidates found this question demanding even though they knew what an anomalous result was. The majority did not notice that 104 and 96 are more similar to each other than to 170 and most circled 96 rather than 170. Some circled an entire row in the table.

(iv) Most candidates were able to select the correct data from the table: 272 and 104. Various calculations were seen with many unsure how to calculate a percentage change. Some divided by the wrong denominator and some divided 104 by 272 or vice versa. Error carried forward was awarded for those that expressed their answer to one decimal place. Candidates needed to show that they knew this was a percentage decrease by including a negative sign with their answer. Some did not round their answer correctly or express their answer to one decimal place. Candidates should show their workings so that even if they make a mistake, they can still be awarded marks for correct rounding.

(d)(i) Some very good drawings were seen with a good level of detail. Most had a clear outline, but many had a broken outline. Some were incomplete and included internal shading. Most drawings were a good size and were not too small. Some drawings went into the surrounding text which was not accepted. The internal 'stripes' on the lower side should have been drawn as double lines, with some seeds shown as circles or ovals. Candidates should take care to note the details in a photograph, such as the number of sepals, or seeds etc., and this should be replicated in their drawing.

(ii) This is a familiar question to most candidates. They accurately measured the line and calculated the actual diameter of the strawberry fruit. The mark most likely to be missed was giving their answer to three significant figures. There was some confusion with decimal places and some just ignored this instruction. Others multiplied by 1.8 rather than dividing by 1.8.

(e) Candidates were confident at describing the Benedict's test. Some forgot to say that the reagent should be heated with the strawberry. If a temperature was quoted it should be greater than 30 °C. It was not necessary to include a description of the expected results.

BIOLOGY

Key messages

When drawing conclusions from an investigation, candidates should reread the aim of the investigation. 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)   The majority of candidates correctly determined the volumes. Some used the correct proportions but did not combine them to produce the required final volume.

(ii)   Most candidates measured the potato discs correctly. Some candidates measured in centimetres rather than the required millimetres.

(iii)   Most candidates were able to construct a suitable table with the correct number of columns or rows and with the headings separated from the body of the table by a line. They could also present the data, although a common error was to miss out a column for salt concentration (the independent variable), often just referring to the letter of the beaker. Another common error was to include units in the body of the table. A few candidates only recorded the change of length, which was not required in the table.

(iv)   The majority of candidates correctly calculated the change in length.

(v)   Some candidates gave an answer in terms of osmosis or correct water movement. Many candidates simply restated the results rather than giving a conclusion.

(vi)   Many candidates correctly identified the potato length as the dependent variable. Weaker responses mistakenly thought it was the salt concentration, or osmosis in potatoes.

(vii)   Many candidates incorrectly referred to improving reliability or accuracy, calculating a mean, or identifying or preventing anomalous results. They found it difficult to explain their answers using precise wording and many only stated that it was 'easier to measure ten discs', or 'hard to measure one disc'. Stronger responses referred to the change in length being too small to measure, or that the effect seen in a single disc might not be representative, or that a large sample would reduce the percentage error.

(viii)   Some candidates gave a correct precaution, such as cutting away from the body or cutting on a flat surface. However, a significant proportion of candidates incorrectly thought that using gloves or just 'being careful' would be appropriate.

(b)   Most candidates could identify iodine solution, but not all could identify that this meant that the potato contained starch. Benedict's or biuret solution were common incorrect responses.

(c) (i)   Most candidates successfully produced a drawing of the leaf which was of suitable size with a double-lined midrib. However, some candidates had a broken outline, or used a ruler to draw the midrib, or used shading. Some candidates did not include the characteristic bulges at the bottom of the leaf. In a few cases the drawing extended into the printed text which was not accepted.

(ii)   The majority of candidates measured the line correctly, although weaker responses measured in centimetres not millimetres. Most went on to correctly calculate the magnification, but fewer were able to present their answer to two significant figures. Some also incorrectly included units, such as mm, with their magnification.

(iii)   This question proved demanding for many candidates. Many used vague or non-comparative language, describing only one specimen rather than contrasting both. Despite the question stem clearly stating that the tomato leaf is narrower than the potato leaf and explicitly asking for a feature other than size, many candidates still based their answer on size or on colour, despite colour not being visible in the diagram. Stronger responses gave a correct difference and a similarity. Most candidates only gave a suitable similarity, e.g., the presence of veins. Some candidates incorrectly referred to the presence of parallel veins.

Question 2

(a) (i)   Some candidates correctly named a thermostatic water-bath as a suitable piece of apparatus. Some candidates just stated to use a water-bath, and weaker responses incorrectly described using a thermometer.

(ii)   Most candidates correctly described at least one variable which was kept constant. Some candidates offered variables which were not named in the question, e.g., type of apple or pH. Some quoted 'temperature' despite the question asking for other variables or stated, 'concentration of pectinase' (the independent variable) or 'volume of juice' (the dependent variable).

(b) (i)   Most candidates answered this question well. They understood that axes need to be fully labelled including units, a suitable linear scale for the data should be chosen, and a line drawn through the plotted data. The most common mistake was extrapolating the graph line to the origin. Weaker responses used the numbers from the table on the percentage concentration axis, and therefore did not use a linear scale, or did not use the entire width and height of the grid to plot their axes, giving a 'squashed' line which did not spread the points out enough to give an accurate plot. Candidates should be encouraged to use the highest number on the axis and work out a linear scale that reaches this number across the plotted area.

(ii)   Most candidates were able to distinguish where 0.5% was on their graph and read off the corresponding value, based on their scale. Some candidates correctly read off their answer without following the instruction to show on the graph how they obtained their answer.

(iii)   The majority of candidates only described the relationship between concentration and the volume of juice. However, stronger responses described that the volume became constant beyond 0.8%.

(iv)   This question proved demanding for most candidates. A key concept tested here was the effect of the interval size of the independent variable. Many candidates found it difficult to grasp that when intervals are too wide, the actual optimum enzyme concentration may be missed. Most candidates only mentioned using concentrations above or below 0.8% and missed stating the need for concentrations at smaller intervals around 0.8%. Weaker responses referred to changing controlled variables, e.g., temperature and pH, or repeating the experiment multiple times.

(v)   The majority of measuring apparatus pieces were shown with gradations with many candidates drawing measuring cylinders. Most candidates labelled their apparatus. Several candidates omitted to use filter paper with the filter funnel. There were a few non-scientific pieces of apparatus drawn, such as sieves or paper towels instead of a funnel and filter paper, and a few jugs for the measuring apparatus. Greater exposure to practical equipment and drawing practice would greatly support candidates in improving this skill. A few candidates included a balance to weigh the juice rather than to measure its volume as required.

Question 3

Candidates generally demonstrated a sound understanding of how to structure an investigation. Many responses showed logical sequencing and an awareness of basic scientific principles. Most candidates were able to give at least two controlled variables, two or more repeats and a suitable safety point. Stronger responses described the independent, dependent and controlled variables, considered reliability and safety and gave clear details of a method that would have been repeatable. The majority of candidates had a good grasp of controlled variables, although a number of candidates stated just time as one of the controlled variables, but did not specify time to see the colour change, or time to equilibrate to the different light intensities. Weaker responses only suggested two different light intensities, usually as a light room and a dark room. Candidates should realise that at least three values for the independent variable must be used to gain any meaningful trend. Weaker responses did not show an understanding of the relevance of the indicator and discussed measuring the volume of carbon dioxide or oxygen as the dependent variable, often counting bubbles. Only stronger responses mentioned the idea of equilibrating at each new light intensity, using a heat shield, or controlling the wavelength of light.