BIOLOGY

Paper 0970/11
Multiple Choice (Core)

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

General comments

There was good understanding of: the function of white blood cells; the definition of inheritance and that amino acids are the products when proteins are broken down.

There was some uncertainty about: breathing as a characteristic of living things; the characteristics of myriapods; the effect of temperature and humidity on transpiration; the site where most of the absorption of water takes place in the alimentary canal, mitosis and osmosis.

It is important for candidates to work carefully and methodically through information provided in the question.

Comments on specific questions

Question 1

Many candidates appreciated that sensitivity is a characteristic of all living things. A few incorrectly opted for breathing, indicating confusion between respiration and breathing.

Question 2

Many candidates opted for the correct answer, although a minority did not know the meaning of the term genus.

Cambridge Assessment
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Question 3

This proved to be a challenging question. The number of candidates selecting each option suggests that many candidates were unsure that having two pairs of legs on each segment is a feature of some myriapods.

Question 6

Many candidates were able to calculate the actual size of the nucleus. Some candidates did not appreciate that to work out the actual size of the nucleus, the image size of the nucleus needed to be divided by the magnification.

Question 8

Many candidates understood that after one hour the mass of the potato cylinder had decreased due to water leaving the plant tissue by osmosis. Some candidates incorrectly believed that salt entered the plant tissue by active transport.

Question 10

Many candidates appreciated that the pH in the stomach is not suitable for the amylase to work. Some candidates incorrectly believed that starch digestion does not take place in the stomach because starch digestion is completed in the mouth.

Question 11

Many appreciated that a catalyst is a substance that increases the rate of a chemical reaction and is not changed by the reaction. Some candidates incorrectly believed that a catalyst is a substance that increases the rate of a chemical reaction and is changed by the reaction.

Question 12

This proved to be a demanding question. Only areas of the leaf that possess chlorophyll would have starch and turn blue-black. The white areas of the leaf would be the same colour as the iodine which is yellow–brown.

Question 16

The fact that the small intestine is the site where most of the absorption of water takes place in the alimentary canal was not well-known.

Question 19

Only a minority of candidates knew the names of the blood vessels carrying blood to and from the kidneys.

Question 20

Few candidates correctly identified the blood vessel as an artery, often confusing it with a vein.

Question 22

It is important that information provided in the question is methodically processed. The graphs showed an increase in depth of breathing and an increase in rate of breathing.

Question 23

This proved to be a very demanding question, with most candidates not appreciating that diffusion does not require energy released by respiration.

Question 24

The products of anaerobic respiration in humans were not well-known. Many candidates incorrectly believed that carbon dioxide and lactic acid are produced. Only lactic acid is produced.

Question 25

Many candidates understood that urea is formed from excess amino acids in the liver and is excreted by the kidneys.

Question 26

The correct sequence of neurones between a receptor and an effector in a reflex arc was not well-known.

Question 27

Most candidates understood that the iris controls how much light enters the eye. Some candidates incorrectly opted for the lens.

Question 29

Only a minority of candidates gave the correct response. It is important for candidates to work carefully and methodically through the information provided. Successful candidates evaluated each statement in turn to deduce that all three conclusions were correct.

Question 31

The structure in the male reproductive system that makes the fluid for sperm to swim in is the prostate gland. The testis was frequently selected.

Question 32

Many candidates were able to correctly work out on which days of the menstrual cycle a woman is most likely to become pregnant.

Question 34

This proved to be a challenging question for many candidates. Mitosis produces identical daughter cells and therefore option **B** was the correct choice.

Question 35

Similar numbers of candidates selected each option, suggesting uncertainty about discontinuous variation having no intermediates between phenotypes.

Question 36

Many candidates appeared uncertain about what secondary consumers are. Some candidates may have deduced the wrong answer by not working methodically through the food chains within the food web to work out which organisms were secondary consumers.

Question 40

Some candidates appreciated that the factors believed to have contributed to the rise in sea levels are pollution of the air by carbon dioxide and methane.

BIOLOGY

Paper 0970/21
Multiple Choice (Extended)

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

General comments

There was good understanding of: the fact that active transport is involved in the uptake of glucose by the epithelial cells of kidney tubules; base pairing in DNA and the development of cholera.

There was some uncertainty about: the characteristics of myriapods; the cells that make antibodies; how the pressure changes in the lungs during inspiration; that the gene for colour blindness is located on the X chromosome and that diffusion of gases does not require energy from respiration.

It is important for candidates to work methodically through information provided in questions, particularly those involving graphs.

Comments on specific questions

Question 3

This proved to be a challenging question. The number of candidates selecting each option suggests that many candidates were unsure that having two pairs of legs on each segment is a feature of some myriapods.

Question 13

This proved to be a demanding question. Only areas of the leaf that possess chlorophyll would have starch and turn blue-black. The white areas of the leaf would be the same colour as the iodine which is yellow-brown.

Question 14

Many candidates appreciated that it can be concluded from the graph that more stomata are closed during light periods. Some candidates incorrectly concluded that more stomata are closed during dark periods. Candidates need to work carefully through the data to avoid errors in interpretation.

Question 17

This question was well-answered, although some candidates mistook the xylem for a mesophyll cell. It could not have been a mesophyll cell, since these cells are found in leaves.

Question 18

Many candidates were able to work out when the onion bulb was acting as a sink and when it was acting as a source. Some candidates incorrectly believed that at stage 3, the bulb was a source and at stage 6, a sink.

Question 20

Many candidates incorrectly believed that component **A** (the phagocyte) makes antibodies.

Question 22

Few candidates appreciated the sequence of changes that take place when we breathe in. Some candidates incorrectly believed that the pressure in the lungs increases at the start of inspiration. The increased volume of the thorax decreases the pressure in the lungs allowing air to flow in from outside.

Question 23

Many candidates did not appreciate that while the production of new red blood cells and the transmission of nerve impulses use energy released by respiration, the diffusion of gases does not.

Question 26

While many candidates correctly identified the states of the iris muscles in bright light, some candidates incorrectly believed that the radial muscles contracted and the circular muscles relaxed.

Question 28

Many candidates realised that auxin is unequally distributed and causes cells to elongate. Some candidates incorrectly believed that auxin moves between the cells by osmosis.

Question 29

While many candidates were able to make the correct conclusions from the graph, some did not appreciate that age increases the risk of lung cancer for smokers and non-smokers.

Question 31

Many candidates appreciated that the concentration of dissolved oxygen would decrease and the concentration of urea would increase as a pregnant woman's blood passes through the placenta. Some candidates incorrectly believed that the concentration of oxygen would increase and the concentration of urea would decrease.

Question 33

Some candidates were uncertain about the features of meiosis. Meiosis allows the formation of new combinations of chromosomes.

Question 34

There was some uncertainty as to whether the gene for colour blindness is located on the X chromosome (correct response) or on the Y chromosome (incorrect response).

Question 35

Many candidates understood that the graph shows discontinuous variation which is caused by genetic factors only. Some candidates incorrectly believed that it showed continuous variation caused by genetic factors only.

Question 38

Many candidates correctly identified the fox as the organism that feeds as both a secondary and a tertiary consumer. Some candidates incorrectly believed the answer to be the blackbird.

BIOLOGY

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Paper 0970/22

Multiple Choice (Extended)

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

General comments

There was good understanding of: active transport in the uptake of glucose by the epithelial cells of kidney tubules; base pairing in DNA; immunity; vasoconstriction and codominance.

There was some uncertainty about: the sequence of organs that blood passes through during one circulation in the body of a fish; the pressure changes in the lungs during inspiration and that bacteria have the same genetic code as humans.

It is important for candidates to work methodically through information provided in questions, particularly those involving graphs.

Comments on specific questions

Question 3

This proved to be a challenging question. The number of candidates selecting each option suggests that many candidates were unsure that having two pairs of legs on each segment is a feature of some myriapods.

Question 14

Many candidates appreciated that it can be concluded from the graph that more stomata are closed during light periods. Some candidates incorrectly concluded that more stomata are closed during dark periods. Candidates need to work carefully through the data to avoid errors in interpretation.

Question 20

The sequence of organs that blood passes through during one circulation in the body of a fish was not well-known.

Question 22

Few candidates appreciated the sequence of changes that take place when we breathe in. Some candidates incorrectly believed that the pressure in the lungs increases at the start of inspiration. The increased volume of the thorax decreases the pressure in the lungs allowing air to flow in from outside.

Question 24

Few candidates understood that during the recovery period the oxygen debt is removed by aerobic respiration of lactic acid in the liver.

Question 31

Many candidates understood what is involved in artificial insemination (AI), although some candidates confused this with *in vitro* fertilisation (IVF).

Question 38

Few candidates were able to use the food web to identify how many organisms fed at more than one trophic level.

Question 39

This proved to be a challenging question. Few candidates appreciated that bacteria have the same genetic code as humans.

BIOLOGY

Paper 0610/31
Theory (Core)

Key messages

Candidates should ensure that they read each question carefully and answer the question being asked. Candidates sometimes see one or two key words and write everything they know about that topic, much of which does not answer the question and cannot be credited.

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.

When drawing label lines, candidates must ensure that the label line ends exactly on the structure being labelled.

When answering comparative questions, it is essential that candidates make comparative statements. Using terms such as 'higher' or 'lower' may enable them to do this effectively.

General comments

There was evidence that candidates had used past papers when preparing for the exam. This is useful as some candidates have a good knowledge of biology but are unsure as to how to express their ideas clearly.

Comments on specific questions

Question 1

The diagram in the published question paper has been amended compared to the version taken by candidates.

Question 2

(a)   Most candidates correctly matched structures **C** and **D** with their function. Matching **B** to the wrong tube was the commonest error.

(b)(i) Most candidates correctly stated egg or ovum but ovule and ovary were common errors.

   (ii) The majority of candidates correctly stated zygote. Embryo and fetus were common errors.

   (iii) Several candidates correctly stated the oviduct but incorrect answers included vagina, uterus and ovary.

(c)   Many candidates were awarded three marks, but some could not be fully credited because they did not write comparative answers. One parent versus two parents was frequently known. A common misconception was that asexual reproduction only happens in plants and bacteria and sexual reproduction only happens in animals. Few candidates referred to fertilisation, variation, gametes, mitosis or meiosis.

Question 3

(a)   Few candidates attempted to describe the overall trend of the graph, perhaps because of the decline in 2011. Many candidates did not attempt to use data from the graph to support their answer, despite clear instructions in the question. The scale proved quite difficult for some candidates to interpret. Many answers referred to speed of change (sharp, fast, sudden), although this terminology was not appropriate for the data displayed. Weaker responses simply described the impact of alcohol on the health of a population.

(b)   Many candidates overlooked the expression short-term in the question and gave long-term effects of alcohol. There was some confusion over the term reaction time as some candidates mistakenly said the reaction time would be reduced whilst meaning it would take longer to react. Many candidates stated effects on other systems, rather than the nervous system.

(c)   Most candidates gave liver, brain or kidney and were awarded a mark.

(d)(i)   The vast majority were able to state the correct reading of pH 8 from the peak of the graph.

   (ii)   Most candidates correctly stated pH 10 for the pH with the lowest enzyme activity, a few incorrectly stated pH 4.

   (iii)   Most candidates correctly stated temperature.

(e)   Most candidates gained at least one mark for their definition of a catalyst. Some answers incorrectly suggested that a catalyst was a cell or organism that increased the rate of reaction.

(f)   Some candidates knew which elements are present in all proteins but a substantial number omitted at least one of carbon, hydrogen or oxygen, or chose an element other than nitrogen.

Question 4

(a)   Almost all candidates were able to identify that aerobic respiration requires oxygen or that it involves the action of enzymes. Few candidates knew that it produces water.

(b)(i)   A large number of candidates correctly identified the effects of adrenaline. The most common incorrect answer was decreased breathing rate.

   (ii)   Some candidates found it more challenging to correctly name the gland that releases adrenaline. The most common errors were pancreas, kidneys and brain. Simply stating adrenaline gland was not accepted.

   (iii)   Candidates needed to link the hormone with the idea that it is transported around the body by the blood. A few candidates incorrectly named the nervous system as a way of hormones being transported around the body.

(c)   Almost all candidates were able to name one of the two hormones responsible for the development of secondary sexual characteristics in humans, oestrogen was the most frequent correct hormone given. The most common incorrect answer was progesterone, but it could not be credited because it is not responsible for the development of secondary sexual characteristics.

(d)   This question was answered very well with most candidates able to name the pancreas as the organ that secretes insulin. The most common incorrect answer was the liver.

(e)   Some candidates found it challenging to correctly place the parts of the body in order of size from smallest to largest. Many recognised that a DNA molecule was the smallest and an organ system was the largest, though some thought a tissue was smaller than a cell.

Question 5

(a)(i)   Candidates must ensure that label lines end exactly on the intended structure. Common errors included labelling the top section of the ventricle as the atrium and confusing the relative positions of the two chambers.

(ii) This question proved challenging with some confusion between the pulmonary artery and the pulmonary vein.

(b) Some candidates misread the question and described where a pulse could be taken or how to take it. Many candidates correctly stated ECG and listening to the valves close.

(c) (i) Few candidates specified the coronary artery. Incorrect responses included artery, vein and the blood vessels to or from the heart.

(ii) Most candidates knew the risk factors for CHD. A common error was to misunderstand what a risk factor is, and to describe CHD symptoms. A few gave factors that would prevent CHD like avoiding alcohol or smoking, taking more exercising, etc.

Question 6

(a) (i) This question was answered correctly by almost all candidates. A common error was to calculate the total number of people, rather than just males.

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(ii) This question was answered correctly by almost all candidates.

(iii) This question proved to be rather challenging. Most candidates simply described the data, rather than discussing the type of data. It is important that candidates can recognise that discontinuous data is in discrete categories with no intermediate values.

(iv) Many candidates gave correct examples although there was some confusion between examples of continuous and discontinuous variation.

(v) Height was the most common correct answer.

(b) Most candidates were awarded at least two marks for this question. Many correctly identified that a mutation is a genetic change and that ionising radiation increases the risk of mutation. Being able to correctly state that mutations form new alleles was more challenging.

Question 7

(a) While most candidates chose an item of farm machinery, used to farm larger areas of land, some incorrectly put descriptions of how the land is cleared or farmed e.g. deforestation, monoculture.

Most candidates correctly stated fertiliser as a method of improving growth in plants, although a few confused this with fertilisation. Most stated insecticides and herbicides correctly.

(b) Candidates should read each question carefully so that they answer the exact question being asked. Some gave references to crop plant production rather than livestock production. Strong responses referred to problems with disease, pollution and the use of antibiotics.

(c) Most candidates correctly ordered the statements describing the process of selective breeding. Occasionally, **B** and **E** were stated the wrong way round.

(d) Most candidates could name factors that could decrease population size. Occasionally, the terms predator and prey were confused.

Question 8

(a) (i) The majority of candidates gave a correct response this question. One error was to ignore information given in the experiment and answer with a general requirement for germination, such as a suitable temperature.

(ii) Many candidates correctly answered this question, but dry soil was a common incorrect answer.

(iii) Few candidates knew the effect of boiling seeds on their ability to germinate. A number incorrectly said that boiling would increase germination due to it being warmer or because boiling gives kinetic energy and allows reactions to happen faster. Others said that seeds would absorb water and so

germinate faster or boiling would soften the outer coat and make it easier to germinate. Stronger responses described enzymes becoming inactive at high temperatures.

(b)(i) Most candidates gave the correct word equation for photosynthesis. Some gave an equation with a mixture of words and symbols, or gave the equation for respiration. A few placed water and/or carbon dioxide on the wrong side, or both sides of the equation.

(ii) Most correctly stated water, but a few incorrectly gave oxygen or light as a requirement for both germination and photosynthesis.

BIOLOGY

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Paper 0970/41
Theory (Extended)

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Key messages

Candidates should be familiar with the command words used in exam questions and should know how to respond accordingly. **Question 3(a)** asked for an explanation for the use of bacteria in biotechnology, but some candidates gave a list of products of biotechnology instead.

Question 6 showed how important it is to read each question carefully, including any information that is contained in diagrams, tables or the text that precedes the question. In an exam, candidates may feel rushed and want to start writing answers immediately, but this can lead to a long answer which contains irrelevant information that gains few or no marks. It may be helpful to practise underlining the key terms and information in past paper questions to help focus on understanding the context of each question.

General comments

In general, candidates responded correctly to the command terms used in this paper. For example, most answers to **Question 2(a)** were confined to descriptions of the data, although some candidates did suggest explanations and gained no extra credit. Information given in the questions should not be repeated in answers.

Some topics from the Supplement section of the syllabus were not fully understood – in particular the role of auxin in gravitropism, the use of bacteria in biotechnology and immunity.

Candidates should be encouraged to answer questions as specifically as possible using the appropriate scientific terminology in the correct context. For example, in **Question 6** some candidates produced vague answers which used the terms pathogen, lymphocyte, phagocyte, antibodies, antigens and antitoxin in ways that suggested they did not understand their precise roles in immunity. The use of words like attack and fight in this context should be discouraged. There was also some confusion between antibodies and enzymes. Antibodies do not have active sites and they do not release enzymes. Many stated that antibodies become or give rise to memory cells.

Comments on specific questions

Question 1

(a) (i) Most candidates identified plants and prokaryotes as organisms that have a cell wall. A common error was to give bacteria which is a group within the prokaryote kingdom. Protist or protoctista was a common answer; however, not all organisms belonging to this kingdom have cell walls.

(ii) The table naming and identifying the cell structures in yeast that are sites of the three functions listed was completed correctly by many. Storage of genes was given as the nucleus (**G**); mitochondrion (**E**) was also accepted as it has DNA. Some candidates completed the last row with either ribosome(s) and **H** or with endoplasmic reticulum and **F**. Ribosomes and **F** was also accepted. Some candidates gave letters but no names. A significant number confused the vacuole with the nucleus, giving **C** as their answer in the first row of the table.

(b) (i) Candidates were asked to convert 2 µm to millimetres. Many gave the correct answer, but there was a very wide range of incorrect answers. Many candidates multiplied by 1000 to give 2000 mm as their answer instead of 0.002 mm.

(ii) The length of the drawing is the other information that a candidate would need to calculate the magnification of the bacterial cell in **Fig. 1.2**.

(c)   There were many very well organised answers to this question comparing the structure of a yeast cell with the structure of a bacterial cell. Most candidates wrote a paragraph stating the similarities between the two and then a paragraph describing the differences. Some presented their answers in a table which is a suitable way to answer this type of question. Most candidates named all the structures correctly, although descriptions of DNA were often too vague to gain credit. The DNA in prokaryotes is best described as circular and DNA in eukaryotes, such as yeast, is best described as linear. Incorrect responses included ribosomes being present in yeast but not in bacteria and references to chloroplasts, which are not present in either of these cells. A fair number of candidates gave differences in size and shape; these answers were not acceptable as structural differences. Poorly organised answers often gave the same feature as a similarity and a difference.

(d)   Candidates were less successful with naming the three processes of the nitrogen cycle shown in **Fig. 1.3**. Process 1 was often identified as nitrification rather than nitrogen fixation. Ammonification was accepted as an alternative to deamination for process 2. Denitrification was a common answer for this process, which was not accepted. Many correctly identified process 3 as nitrification. A number of candidates described the processes, often converting the information provided in **Fig. 1.3** into statements instead of naming them.

Question 2

(a)   Some candidates wrote excellent descriptions of the data on the Great Pacific Garbage Patch (GPGP), illustrated with suitable data points taken from **Fig. 2.1**. These answers identified three aspects of the pattern shown in the bar chart:

- higher quantity of plastic waste inside the GPGP between 1965 and 2015
- no increase in plastic waste inside the GPGP from 1965 to 1984
- a steep increase in the quantity of plastic waste inside the GPGP from 1985 to 2015
- fluctuating quantities of plastic waste outside the GPGP between 1965 and 2015.

These answers were mostly illustrated with comparative data quotes with the correct units. Weaker responses stated the quantities shown in the bar chart without describing any trends and often omitted the unit. A few did not make it clear whether they were discussing the inside of the GPGP or the outside. Some candidates gave far too many data quotes. It is advisable to give three or four as a maximum and concentrate on transcribing the values from the graph correctly.

(b)(i)   Most candidates gave some feature of the skin of reptiles. Words often used were hard, leathery and scaly. Scales was accepted as an alternative. A smaller number of candidates referred to the features of eggs, describing them as harder or shelled. Very few referred to internal fertilisation or laying eggs on land.

(ii)   There were many good answers outlining the dangers of non-biodegradable plastic waste in the oceans. Candidates described the effects of this waste on movement, breathing and digestion of marine animals, such as turtles. Many also described the effects of sharp pieces of plastic in causing injuries and the effects of turtles eating plastic bags. Some candidates dealt with indirect effects, such as blocking light so that producers in marine environments cannot photosynthesise efficiently so there is a reduction in food entering the food web for marine animals to eat. Some candidates described the effects of micro plastics.

(iii)   Candidates were also good at suggesting ways in which the quantity of plastic waste can be reduced. Many stated that more plastic should be recycled and more plastic goods should be reusable. There were many good examples of alternatives for plastic, such as paper straws. Instead of describing how plastic waste can be reduced, some candidates described ways in which pollution by plastic could be reduced. Some identified burning plastic waste and increased use of landfill as suitable strategies, which did not answer the question.

Question 3

(a)   Candidates sometimes misread this question and wrote about the ways in which bacteria are used in biotechnology; for example, to produce different foods, drinks or medicines. Better answers described the features of bacteria that make them useful in biotechnology, such as their fast reproduction rate and their ability to make complex molecules. Some candidates included

statements to the effect that bacterial DNA is the same as human DNA or that bacteria have the same genes as humans, which is not correct. Better answers stated that the genetic code is universal and explained the advantage of this for biotechnology. Candidates were often not clear in describing how the genetic code of all organisms is the same. Some referred in colloquial terms to this phenomenon, stating that all organisms share a common language. Plasmids were often mentioned, including reference to their use in the genetic modification of bacteria.

(b) (i) Most candidates identified the pancreas as the organ that contains insulin-producing cells. The liver was the most common incorrect answer.

(ii) Diabetes was given by most candidates. Many referred to it correctly as type 1 diabetes, although that was not necessary to gain credit. References to autoimmune disease were also seen, but not credited as this is a category of disease.

(iii) The role of insulin was often given as controlling blood glucose or regulating blood glucose. These answers were not accepted. Instead, decreasing the concentration of glucose in the blood or reducing blood glucose were accepted. More detailed answers describing the stimulation of liver cells to increase the uptake of glucose were also awarded credit.

(c) (i) Candidates had to complete a graph showing changes in the numbers of living bacteria in samples taken from a fermenter over six hours. The answers should have been taken from the stem of the question. The *x*-axis was often correctly labelled with time, hours or days. The *y*-axis label needed to refer to numbers or population of bacteria in 1.0 mm^3.

(ii) Some candidates correctly named all four stages of population growth shown in **Fig. 3.1**. Some confused the lag and log stages and some gave simple descriptions of the stages, for example: increasing stage and number stays the same.

(iii) Candidates rarely explained why the bacteria had not grown for longer than five days in the fermenter. Many described the growth of the population as shown in **Fig. 3.1** by saying that the bacteria all died. Better answers explained that certain factors limited the growth of the bacteria in the death or decline phase. Candidates gave examples such as exhaustion of nutrients and oxygen, build-up of wastes and an increase in temperature. Some stated that there would be increased competition between bacteria for resources. Few stated that the pH would become unfavourable or more acidic. The term resources is too general and was not accepted as an alternative to named resources, such as nutrients and oxygen.

(d) Most candidates stated that iron is required for the production of haemoglobin inside red blood cells and that it is involved in the transport of oxygen. Anaemia was frequently mentioned, often with a correct symptom. However, the role of iron in the diet and the effects of an iron deficiency were often confused with the importance of calcium and vitamin D. Answers that described building bones, rickets and weak bones were seen quite often, as were kwashiorkor and marasmus.

(e) (i) Many candidates gave restriction enzymes, endonuclease or restriction endonuclease as their answer. All were given credit. Common incorrect answers included protease, amylase, pepsin and ligase.

(ii) Many candidates did not describe how recombinant DNA can be formed. However, there were some excellent answers that referred to cutting the cassava DNA with the same restriction enzyme so that the sticky ends of the two pieces of DNA would be complementary. The role of ligase in attaching the DNA from the two sources was often included in these answers.

(iii) Many candidates interpreted this question as asking about selective breeding by artificial selection. There are a variety of reasons why scientists continue breeding new GM varieties for several generations before releasing them on the market. One of these is to ensure that the feature or features that have been incorporated by genetic engineering are inherited and expressed in all the plants in future generations. In addition, scientists want to make sure that the plants will grow well in field conditions and have no harmful effects. Few candidates were aware of the need for quality control.

Question 4

(a)   Candidates gave a variety of answers for the response shown by plant **B** in **Fig. 4.1**. Phototropism was a common incorrect answer as candidates thought the plant was responding to light even though the diagram shows the two plants enclosed in a box that excludes light. Some candidates gave positive gravitropism, but this was not accepted.

(b)   Candidates who thought the investigation was about phototropism explained that plant **A** was rotated on a clinostat to receive light on all sides. Better answers stated that this was to ensure that all sides of the plant received the same pull of gravity. Many interpreted this question in terms of even distribution of auxin in the plant and this was credited. Few went on to say that plant **A** was included as a control to compare with the response shown by plant **B**.

(c) (i)   Many candidates correctly named the plant hormone as auxin.

(ii)   There were some detailed explanations of the control of negative gravitropism by auxin. Candidates who thought light was involved could gain some marks if they knew that auxin diffuses down the stem from the shoot tip and stimulates cell elongation. Some wrote their explanations about roots rather than about stems. The role of auxins in cell elongation was rarely seen.

(d)   Answers to this question revealed little appreciation of the needs of plants. Most candidates rarely stated more than plants need light for photosynthesis. Better answers added further information about the requirements of shoots, including being able to take up carbon dioxide for photosynthesis, or holding flowers where insects could reach them easily for pollination. Comments about the positive gravitropic response of roots referring to absorption of water and ions (not nutrients or resources) and anchorage in the soil were also credited.

Question 5

(a)   Almost all candidates correctly used label lines and letters to identify the four organs of the female reproductive system. A small number did not use label lines and simply wrote the letters on the structures. Marks were awarded if it was clear which structures were being labelled. Many candidates correctly identified the structures from the descriptions of their functions. **Q** was accepted anywhere from the funnel-shaped opening of the oviduct to the point where the oviduct joins the uterus. Many, however, were not able to identify all four areas, and some could not identify any at all. Sometimes little care was taken over the label lines; these were rarely drawn with a ruler and sometimes they did not end on the structures being labelled.

(b) (i)   This question on the stores of protein and fat in egg cells was poorly answered. Many candidates relied on knowledge of human nutrition and stated that protein is needed for growth and repair and fat for insulation. Better answers referred to fat as a source of energy and listed some of the processes that occur after fertilisation that require energy. Some thought that energy is needed for the egg cell to move. Protein proved more difficult. Few candidates referred to the uses of stored protein in providing amino acids for the protein synthesis needed to make new cells after fertilisation.

(ii)   Many candidates correctly stated that the jelly coat that surrounds eggs prevents the entry of more than one sperm at fertilisation. Few stated that to do this the jelly coat goes through changes, often described as a hardening, which makes the coat impenetrable to more sperm. Many simply stated that the jelly coat provides protection.

(c)   Detailed answers were seen in response to this question on the development of a zygote into an embryo. These answers concentrated on mitosis and cell division, describing how a zygote divides into a two-celled embryo and then into a ball of cells. Few used their knowledge of mitosis to explain that chromosomes must duplicate and separate before a cell can divide. Some candidates were unsure about the terms zygote, embryo and fetus, stating that an embryo divides many times to form a zygote or assuming the terms embryo and fetus are synonymous. A common error was to state that cells in the embryo divide by meiosis. Some candidates stated that the cells divide by mitosis and meiosis.

Question 6

(a) (i)   Many candidates found it difficult to explain the advantage of giving the person an injection of antitoxin antibodies. Few stated that this provides passive immunity which gives immediate protection against the diphtheria toxin. Candidates often described active immunity or just stated that the antitoxin antibodies neutralised the toxin, which did not gain credit as it is in the stem of the question.

(ii)   There were some good answers to this question on active immunity with candidates often explaining that memory cells are produced. The long-term nature of the protection against diphtheria was often identified. A few used **Fig. 6.1** to write about the increase in antibodies during the first and second injections, comparing this with the decrease in antibodies in passive immunity. Few mentioned the speed of response following the second injection. Quite a few candidates referred to better immunity which was not accepted. Some candidates simply wrote a comparison between the two types of immunity and provided unnecessary detail.

(b)   There were good answers to this question on the ways in which antibodies protect the body against pathogens. Candidates referred to antigens, explaining that antibodies are specific to each antigen as they have complementary shapes. The role of antibodies in identifying pathogens for destruction by phagocytes was often included. However, although many candidates knew some of the terminology relevant to this question, they often had little understanding of its meaning. For example, many wrote about antibodies as though they were cells, describing how they secreted chemicals, produced memory cells or performed phagocytosis. In some cases, antibodies were said to produce antigens. A common mistake was to discuss the immune response more generally rather than focusing on the action of antibodies.

(c)   Knowledge of the lymphatic system was generally weak. The transport of fat, draining of tissue fluid and return of tissue fluid to the blood were not seen very often. Many answers referred to the production of memory cells or other aspects of the immune response, despite the question stating that such functions would not be credited. Some candidates used the correct key terms, but their statements were insufficient or incorrect for credit to be awarded. Examples included, 'makes tissue fluid' and 'drains body fluids'.

BIOLOGY

Paper 0970/42
Theory (Extended)

Key messages

Questions 1(b)(iii), **4(a)(ii)** and **(b)(i)** showed how important it is to read each question carefully. In an exam, candidates may feel rushed and want to start writing answers immediately, but this can lead to a long answer which contains irrelevant information that gains few or no marks. It may be helpful to practise underlining the key terms and information in past paper questions to help focus on understanding the context of each question

Candidates should know the specialist terms that are used in biology at this level. They should also understand the meanings of these terms and be able to use each term is context. These skills were tested in **Questions 2(b)(ii)**, **3(b)** and **6(a)(ii)**.

Candidates should spend time considering all the information in graphs, charts and diagrams before starting to write an answer. They should look carefully at the axes labels and units, any key provided and the trend or pattern visible in the data. Some candidates did not look carefully at the time scale in the diagram in **Fig. 2.3** before answering **Question 2(b)(ii)**.

General comments

Some excellent data analysis was seen in **Questions 2(b)(ii)** and **5(b)(ii)**, often supported by good use of the data in the figures. Responses to questions that assessed knowledge with understanding rarely included the scientific detail that was necessary to receive full credit.

Comments on specific questions

Question 1

(a)   Most candidates knew that the central nervous system includes the brain and spinal cord, but fewer candidates also knew that the nerves coming into and out of the spinal cord are part of the peripheral nervous system.

(b)(i)   Many candidates identified the motor neurone on the diagram. A considerable number of candidates identified the neurone incorrectly as the sensory neurone.

(ii)   The fovea (**J**) was the most common correct answer given in the table. Common errors were to state that suspensory ligaments contract and mistaking circular muscles for ciliary muscles.

(c)(i)   The most common correct example of energy usage was muscle contraction; the conduction of nerve impulses was seen less frequently. Incorrect answers often described the contraction of the suspensory ligaments.

(ii)   Almost all candidates knew that haemoglobin is the molecule in red blood cells that carries oxygen.

(iii)   Many candidates knew that oxygen diffuses out of capillaries, but fewer candidates went on to give an explanation in more detail. Few candidates referred to the thin capillary wall when describing the pathway and even fewer stated that the diffusion of oxygen to cells in the eye is a passive process.

(d)(i) The skin and the hair in the nose were the mechanical barriers to pathogens given by most candidates. Some candidates did not gain credit because they did not qualify the location of the hairs or suggested cilia instead.

(ii) Many candidates stated that phagocytes digest pathogens, although a significant number named them as lymphocytes.

(iii) Some detailed accounts describing the specificity of antigens and antibodies were seen. However, many candidates seemed unfamiliar with key terms, such as antigen, and wrote vague descriptions. Some candidates knew that antibodies were involved, but did not elaborate to give further detail.

(e) Many candidates correctly stated that insects and crustaceans are arthropods. Invertebrates and arachnids were the most common incorrect answers.

Question 2

(a) A wide range of dietary components were identified as being likely to be found in bamboo compared with fish. The most common was dietary fibre, but starch and sugars were also seen frequently. Unfortunately, some candidates mentioned vitamins without specifying vitamin C.

(b)(i) Almost all candidates knew that fur is an identifying feature of mammals. However, fewer candidates stated specifically that they have external ears. Some candidates recognised ears as a feature, but did not qualify this with external. Ears and visible ears were not accepted. Candidates should know that ears are not unique to mammals.

(ii) There were some excellent discussions for and against the statement that the giant panda is more closely related to the red panda than the polar bear. The similar diets of the two pandas and their similar habitat being the most common arguments in support of the statement. However, some candidates thought that the name panda was a genus name and gave this as an argument while others thought that because *Ailuropoda* and *Ailurus* start with the same letters, that this meant the two genera were more similar. Many candidates also demonstrated a good understanding of the classification diagram and used the data to support the points that they made against the statement. They successfully argued that the shorter distance to the branching point meant that there were fewer DNA differences between them, supporting the idea that the common ancestor of the giant panda and the polar bear was more recent than the common ancestor of the giant panda and the red panda. The most able candidates went on to support this argument with a comparative data quote taken from **Fig. 2.3**. Common errors were to give only one time period and to confuse the species that were being discussed.

(iii) Many candidates stated that anatomy was another type of evidence used to classify species. A less frequent, but correct answer, was behaviour. However, there were also many incorrect answers, such as phenotype, characteristics or DNA. These answers suggested that those candidates had not read the word 'other' or did not realise that they had been comparing morphological and DNA evidence.

Question 3

(a)(i) The sequence of events that occur during the menstrual cycle seemed unfamiliar to a considerable number of candidates.

(ii) Many candidates correctly stated that FSH stimulates the development of the follicle.

(iii) Many candidates realised that menstruating females need more iron than females who are not yet menstruating; some candidates explained why the extra iron is required.

(b) Many detailed descriptions of the events between ovulation and the formation of a fetus were seen. Candidates who described the cycle did so confidently using a great deal of detail and scientific terminology. However, some candidates did not use the terms egg, zygote, embryo and fetus correctly, often writing them in an incorrect sequence. Others interchanged the terms throughout their answer. Some candidates matched the wrong labels on **Fig. 3.2** to the structures that they were describing.

Question 4

(a) (i) A wide variety of reasons why plant species could become endangered were given. Many candidates discussed aspects of climate change rather than focusing on plant species, which did not answer the question.

(ii) Many excellent accounts describing how human actions are causing climate change were seen. A few candidates seemed unfamiliar with the specific term climate change and discussed other impacts on the atmosphere, such as acid rain or the destruction of the ozone layer. Another common error was to state that the greenhouse effect was caused by the factors discussed rather than being enhanced by them. Other candidates did not read the question carefully and instead described the consequences of climate change.

(b) (i) A large number of candidates misread the question and described the purpose of storing seeds in seed banks rather explaining why seeds from many populations are collected.

(ii) Many candidates realised that ionising radiation could cause mutations in the DNA. Other candidates correctly stated that cell damage might occur. However, many candidates wrote vague statements about the radiation affecting the seeds, without being specific that the impact was most likely to result in mutations.

(iii) Those candidates who understood that respiration relies on enzyme activity wrote detailed answers describing how low temperatures would result in less kinetic energy and fewer successful collisions. However, many candidates misread the question and stated that low respiration rates would result in low activity in the seeds.

(c) (i) Almost all candidates knew that water is required for germination, though some stated humidity without explicitly stating high humidity. A considerable number of candidates also simply listed temperature or warmth as a condition, without qualifying that a suitable temperature is required. Many candidates also listed light, often with reference to its importance to photosynthesis. Although light can break dormancy in some seeds, this is not a universal requirement for germination and needed to be qualified to gain credit.

(ii) The importance of large roots was well explained by many candidates. It was apparent that some candidates did not understand the concept of germination and were describing the importance of large roots in order for germination to occur. Some candidates did not specify that water and minerals are absorbed by roots, instead using vague terms such as nutrients.

(iii) It was more common to see lag phase than death phase as the part of population growth curve where the number of individuals is very low. A number of candidates seemed unfamiliar with the names of the phases and gave sensible, but incorrect suggestions.

Question 5

(a) A large number of candidates correctly completed the sentences about the reproduction of bacterial cells. Those that were less familiar with the process used the diagram to help them and deduced that the number of DNA loops in each daughter cell was the same. The candidates often described the daughter cells as being genetically similar, rather than genetically identical.

(b) (i) Most candidates selected the correct line on the graph and read the peak value as 3 µm. Many went on to correctly divide this number by 1000 to convert to millimetres. The most common errors were to multiply by 1000 and to read the peak value from the wrong set of data. Where candidates stated the wrong value, those who showed their working in the conversion gained some credit. Similarly, those who read the correct value, but made an error in the conversion, also gained some credit.

(ii) Candidates who were confident in analysing data used the information from **Fig. 5.2** to reject the student's conclusion that cells must be at least 6 µm. Almost all of these candidates included the correct units with the data that they quoted. However, there were many confused responses that did not use the idea of dividing cells or were not clear about the significance of the data on cells before and after division.

(c) (i) A number of candidates had a thorough understanding of genetic engineering and gave very detailed accounts of how plasmids are cut. Conversely, other candidates confused restriction enzymes and DNA ligase, or were less familiar with this topic and gave vague answers.

(ii) The full range of reasons why bacteria and single-celled fungi are useful to the biotechnology industries were seen. It was common to see examples of the products that bacteria and fungi produce rather than reasons why they are useful. This suggested that the question had not been read carefully.

Question 6

(a)(i) Many candidates correctly predicted that the leaves that were enclosed in the transparent bag would not lose as much mass as those that were not in a bag. A considerable number of candidates thought the opposite, or made statements about water collecting in the bag, rather than about the leaves. Some responses discussed photosynthesis instead of transpiration or described how the leaves would take in the water from the air in the bag.

(ii) Many candidates wrote very detailed accounts describing transpiration. Where errors occurred, candidates often referred to evaporation from the surface of the leaf or did not consider the process of diffusion in the loss of water vapour.

(iii) Many candidates realised that a balance or a timer would be needed to take measurements in the investigation, but few realised that both would be needed. Many candidates misread this question and stated the data that they would collect or considered other variables in the investigation. Some thought that a potometer would be required. These candidates did not look carefully at the experimental set-up in **Fig. 6.1**; transpiration rates of leaves hanging on a string line cannot be measured with a potometer. Thermometers and measuring cylinders were other common incorrect answers.

(b) Almost all candidates named at least one of the tissues in the diagram of the leaf in **Fig. 6.2**. In some cases, the diagram was not labelled despite many candidates completing **Table 6.1** correctly. A common error in the table was to state that chloroplast was the tissue that traps the most light, suggesting that those candidates had not realised that a tissue, not a cell structure, was required.

BIOLOGY

Paper 0970/51
Practical Test

Key messages

Candidates must ensure that they read the questions carefully before starting to answer. This is particularly important for planning questions. Identification of the dependent and independent variables is vital before a plan is completed.

When asked about safety considerations, candidates should be able to identify a risk, but also be able to 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 answers are realistic.

General comments

Candidates displayed good skills when drawing graphs. Most candidates have understood the key points of drawing biological specimens and applied these skills when drawing the cell.

Comments on specific questions

Question 1

(a) (i) Almost all candidates were able to correctly calculate the correct value for the concentration of the sugar solution in test-tube **C**.

(ii) The results tables were generally appropriate, with suitable arrangement of columns and rows and adequate numbers of measurements. Candidates should remember that units should not be written in the body of the table and the units should match the values shown.

(iii) Many candidates found this question challenging. In this case, the use of the terms accuracy or reliability were not appropriate for explaining why the potato cylinders were all cut to the same length at the start. A few candidates correctly identified the need for comparisons and fewer still identified that length would affect the surface area.

(iv) Most candidates correctly identified the independent variable. Candidates should be specific in their answers. For instance, concentration of sugar solution rather than amount of sugar.

(v) In this question candidates were asked for two improvements to the method. Answers tended to be too vague, although some did identify that measuring the mass was a better method than measuring length.

(vi) Many candidates simply recalled standard laboratory safety techniques rather than methods of reducing the risk due to cutting. The use of latex gloves alone would not be sufficient to prevent cuts form a scalpel.

(b) The planning question asked candidates to plan an investigation into the effect of temperature on osmosis in plant tissues. The standard of plans was generally high with some well thought out and comprehensive answers.

Cambridge Assessment
International Education

When writing plans candidates should remember:

- there needs to be at least two repeats (three trials in total)
- a method of maintaining the temperature should be included (a water-bath alone is not sufficient – it needs to be a thermostatically-controlled water-bath or the temperature is maintained using a Bunsen burner or ice depending on the required temperature)
- measurements need to be taken at the start and at the end in order to identify any change in length or mass
- controlled variables need to be relevant to the investigation being planned.

(c) (i) The majority of candidate correctly described the test for starch and the positive test result. Candidates would benefit from being specific in their answers. For instance, iodine solution rather than iodine and blue-black rather than black or dark blue.

(ii) The drawings of the plant cell were generally very good, with some clear images that were of a suitable size. Some candidates would benefit from using single, unbroken lines and paying close attention to the required detail. A few candidates forgot to label a starch grain; this highlights the importance of reading the questions carefully.

(iii) The calculation of the actual diameter of a starch grain was done well by the majority of candidates. The best responses showed all of the working and obtained a correct value of 0.013 mm. Values given in centimetres or micrometres were also acceptable. Candidates must ensure that they understand the difference between significant figures and decimal places.

Question 2

(a) (i) Candidates were required to draw a graph of pulse rate after exercise against time. Most graphs were well constructed with accurate plotting of points and well labelled axes. Some key points to consider when drawing graphs:

- Plotted points should be as small as possible, but must still be visible. This could mean plotting small neat crosses or a circled dot. Large plotted points cannot be awarded marks.
- Scales on axes do not have to start at zero. However, it must be clear that a scale starts at a value other than zero, or that a jump is made from zero to the first plotted point.
- A line of best fit does not have to be a straight line; it can also be a curve. In this case a straight line was not suitable as the pulse rate was levelling off. The line should not have gone through the origin, giving a pulse rate of zero.
- Lines of best fit should not show extrapolation unless specifically asked for in the question.

(ii) When describing the relationship from a graph or table of data, it is essential that both variables are mentioned. Simply stating that 'the line goes down' is insufficient. In the data presented to candidates in this question, mentioning the fact that the pulse rate levelled off was also worthy of credit.

(iii) Most candidates were able to select the correct data for the calculation of percentage change in pulse rate (156 and 62). Far fewer were then able to manipulate that data to obtain a correct value for the percentage decrease in pulse rate. As with **Question 1(c)(iii)**, knowing the difference between significant figures and decimal places is essential.

(b) In this question, candidates needed to realise that the table of data contained an anomalous result. Most answered this well, although some assumed that the student had made a mistake in their calculation rather than missing out the anomalous data.

(c) This question required a comparison between the visible features of a vein and an artery. It is important to remember that the question required visible features, so answers such as 'the artery carries blood at high pressure' cannot be credited as this is not a visible feature of the specimens and relies on theoretical knowledge of blood vessels.

Candidates should also be reminded that comparative statements need to mention both blood vessels or contain comparative words. 'The artery wall is thick' would not be credited because it is not comparative. 'The artery has a thicker wall' would be acceptable as this is a comparative statement.

BIOLOGY

Paper 0970/61
Alternative to Practical

Key messages

Candidates must ensure that they read the questions carefully before starting to answer. This is particularly important for planning questions. Identification of the dependent and independent variables is vital before a plan is completed.

Mathematical questions may specify that a numerical answer be given to a specific number of decimal places or significant figures. It is important that candidates understand the difference and can manipulate data appropriately.

General comments

Candidates displayed good skills when drawing graphs. Most candidates have understood the key points of drawing biological specimens and applied these skills when drawing the cell.

Candidates should use a pencil when drawing diagrams, constructing a table, plotting points and drawing a line on a graph. This means that mistakes can be rectified easily and clearly.

Comments on specific questions

Question 1

(a) (i) Many candidates correctly completed the table by inserting the concentration of sugar solution produced when given volumes of water and 1 mol per dm^3 sugar solution were mixed. Some candidates did not understand the calculation required and many of these stated the answer as 1.5 mol per dm^3, which was more concentrated than the sugar solution before dilution.

(ii) Candidates were asked to measure the length of four potato cylinders and then record these lengths in a table they had previously constructed. Most candidates produced a suitable table and recorded the four lengths, usually accurately measured. Many candidates missed the mark for the headings in the table, as the units were not stated or were repeated in the body of the table. Additionally, many candidates omitted the word length (of potato cylinder) from the heading. Ideally, measurements should be in millimetres rather than centimetres. However, measurements in centimetres were accepted provided that the units were stated clearly.

(iii) This answer required an explanation for starting the investigation with all potato cylinders having the same length. Acceptable responses were that the results would be comparable, that variations in surface area would not affect the results, or that the sugar concentration would be the only variable which was changed. Weaker responses gave vague answers involving accuracy, reliability and repeatability. These were not credited.

(iv) The independent variable was identified as the concentration of sugar solution by nearly all candidates. A few incorrectly gave the volume of water added.

(v) Most candidates gave at least one relevant improvement to the method and many could provide two. The most common answers were to measure the mass of the cylinders, to keep the temperature constant, to soak the cylinders for longer and to repeat the investigation.

(vi) Candidates were asked to describe a safety precaution to take when preparing the potato cylinders. The majority seemingly gave little thought to the precise situation and suggested wearing gloves or cutting carefully. These suggestions were too vague. In this situation, a relevant precaution would be to cut the potato when it is on a flat surface or to make cuts away from the fingers.

(b) The quality of the experimental designs described was generally high, and many detailed descriptions were produced. Those candidates that did not gain full marks tended to set up the investigation, but neglected to say when and how the results would be collected. Some responses described an investigation involving uptake of coloured dyes by a plant, which suggested some confusion with transpiration rather than an investigation of osmosis.

(c) (i) Most candidates were familiar with the use of iodine solution to test for the presence of starch and knew that blue-black was the colour of a positive test.

(ii) Candidates were shown a photomicrograph of cells containing starch grains and were asked to draw a diagram of the central cell and then label one starch grain. The majority performed the task well and there were some excellent diagrams produced. Line quality continues to be the main problem when drawing diagrams. Lines must be clear and continuous. Starch grains were often drawn haphazardly with curls and line breaks.

(iii) Candidates had to measure the diameter of one particular starch grain shown on the photomicrograph. The great majority performed this accurately. The units, millimetres, were given and most gave their answer using this unit. Some candidates measure in centimetres, and whereas this was accepted if the units had also been changed, most candidates left the units as mm and so were not awarded that mark. Following this, candidates were required to calculate the actual size of the starch grain, the magnification having been given on the photomicrograph. The majority carried out the calculation correctly. Many candidates were unsure how to express a number to two significant figures.

Question 2

(a) (i) Candidates were asked to plot a graph using the information given in a table. There were some excellent graphs produced which gained full marks. In general, the axes were labelled with units and the plotting was accurate. Most candidates started the scale for the pulse rate at zero. This was accepted, but it needs to be noted that starting this scale at, say, 60 beats per minute, displays the results to a larger scale, which is preferable and more informative.

Candidates had been asked to draw a line of best fit and many candidates interpreted this as a straight line of best fit, which was inappropriate here. A smooth curved line of best fit was needed. A line drawn with a ruler point-to-point was also accepted.

(ii) Candidates were asked to describe the relationship between pulse rate and time shown by their graph. Nearly all candidates stated that the pulse rate decreased as the time increased and so gained one mark. This question carried two marks, but many candidates omitted to describe any other point. Where two marks are allocated to a question, two distinct points must be made. In this case, candidates could have stated that the greatest decrease in pulse rate occurred during the first minute (after exercise stopped), or that the pulse rate had returned to the pre-exercise level by the fourth minute. Some candidates merely quoted data from the graph, but this gained no credit without a stated link to the relationship between pulse rate and time.

(iii) Candidates were asked to work out a percentage change. The calculations were generally correct and most stated an answer to two decimal places.

(iv) Almost all candidates could state that the pulse rate was the dependent variable in this investigation.

(b) This question tested the understanding of anomalous results and the fact that they should be excluded from calculated averages. This is another example where candidates needed to note that two marks are available, so they must make two distinct points in their response. Almost all candidates could identify the anomalous result (an outlier), but many made no further points. Stronger responses went on to explain that anomalous data would not be included in the average calculation as the average would be skewed.

(c)   Candidates were asked to study an image of an artery and an adjacent vein and to state one similarity and two differences which could be seen. Weaker responses included recalled facts and did not include visible features from the image – common answers being based on the direction of blood flow and the level of oxygenation of the blood. Some candidates did not clearly state whether they were referring to the whole structure, or to one particular aspect. For example, the artery is thicker could mean that the entire structure is bigger than the vein (which is incorrect) or that the artery wall is thicker than the wall of the vein (correct). Such ambiguous answers are not given any credit. It must also be noted that the response must be comparative: for example, the lumen of an artery is small, is insufficient as there is no indication of how this compares to a vein.

BIOLOGY

Key messages

Candidates must be familiar with the terms: independent variable, dependent variable and controlled variables. In addition, candidates should understand when a control needs to be used and be able to describe the purpose of the control.

Mathematical questions may specify that a numerical answer be given to a specific number of decimal places or significant figures. It is important that candidates understand the difference and can manipulate data appropriately.

General comments

Many candidates were well-prepared for this exam. The majority of table designs, drawings and graphs were of a very high standard, demonstrating that candidates had practised these skills.

Comments on specific questions

Question 1

(a) (i) The vast majority of candidates were able to calculate the percentage concentration of celery extract for beaker **C**.

(ii) Most candidates demonstrated good table drawing skills. Many chose suitable column headings and were able to convert the data to times in seconds. The most common mistake was to put units in the body of the table or to record the units for time as secs rather than s. Some candidates did not convert to seconds, or recorded 166 for **D** and/or 119 for **E**.

(iii) The majority of candidates gave a comparative statement as a conclusion for the investigation, describing the relationship between the independent variable and the dependent variable. Some went as far as relating the time taken for the paper disc to rise to the speed at which hydrogen peroxide is broken down to oxygen and water.

(iv) The independent and dependent variables were identified correctly by many candidates. The most common mistake was identifying the dependent variable. Some stated that it was the rate of oxygen production and others described controlled variables, such as the volume of hydrogen peroxide.

(b) (i) A variety of responses were given for this question, but many understood the idea of calculating rate. It is important that candidates read the question carefully so that they understand what was being measured in the question. Several discussed counting bubbles or measuring the volume of oxygen produced, neither of which were relevant to this investigation. Some realised that they would need to know the distance travelled by the paper disc and the time taken to travel that distance, but divided time by distance, rather than distance by time.

(ii) Contamination through the use of the same measuring cylinder was identified as the source of error in step 4 by most candidates. Some candidates incorrectly thought that a measuring cylinder was not an accurate piece of equipment for measuring volume.

(iii) There was some confusion between controlled variables and the use of a control. Many candidates described controlled variables, such as using a set temperature or using the same volume of hydrogen peroxide. Some thought that 100% catalase was the control, rather than using water with no catalase or boiled catalase.

(c) Some excellent plans were seen, especially from those candidates who described a new method rather than trying to adapt the given method. These candidates often explained how to measure the volume of oxygen produced in a set time using a gas syringe. Many correctly identified several variables that needed to be controlled and referred to the use of a thermostatically controlled water-bath.

(d) The biuret test for protein and a purple colour for a positive test were well-known by the majority of candidates.

Question 2

(a) (i) The majority of candidates drew holly leaves with the correct number of prickles and included side veins. Candidates must remember that the outline should be clear and continuous. Some missed a mark because they had drawn leaf veins extending beyond the leaf outline. Most candidates remembered not to shade the drawing.

(ii) When measuring diagrams in a question such as this, it is preferable to measure in millimetres rather than centimetres, although answers given in centimetres were accepted. A few candidates gave units for their magnification and could not be awarded the mark.

(b) (i) Many candidates correctly calculated the average number of prickles per leaf. However, some candidates did not give the total number of leaves collected at 2.0 metres above ground.

(ii) A significant number of candidates suggested ways to improve the investigation, rather than what was done to make the sample representative. Many also suggested criteria for choosing the leaves, such as choosing the same size leaves. Candidates must ensure they read questions carefully and use the information available to help them accurately answer the question.

(iii) Most candidates were able to plot a line graph of the data in Table 2.1. Generally, axes were labelled correctly, with units given, and scales were even. Some did not plot the point at 1.5 m. The most common error was in drawing a line of best fit. Those that joined the data plots point-to-point with a ruler got the mark. However, those that attempted a line of best fit often did not extend their line as far as the last plot and so were not awarded the mark. An accurate line of best fit should have approximately the same number of points above and below the line. Candidates should always try to choose a logical scale that makes it easy to plot their points, e.g. with each small square worth either one or two prickles.

(c) Most candidates counted the number of prickles on Fig. 2.2 and used their graph to determine a height.

(d) The use of iodine solution to test for starch and a blue-black colour for a positive test result was well-known by the majority of candidates.