BIOLOGY

Paper 0970/11
Multiple Choice (Core)

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

General comments

The exam paper provided a balance of questions and challenge for candidates working at this level. There was some uncertainty about the difference between the terms '*genus*' and '*species*.' It was also not well-known that not all plant cells contain chloroplasts. Some candidates understood what is required for osmosis to occur but fewer were certain about the differences between active transport, diffusion and osmosis. The approximate percentage of oxygen in expired air was not well-known. Food tests were not clearly understood by all candidates. The use of dichotomous keys and the structure of a leaf were well-understood.

Comments on specific questions

Question 1

While many candidates correctly identified the characteristic of living things as nutrition, some incorrectly opted for respiration.

Question 2

The commonest misconception was that *Homo* denotes the species rather than the genus.

Questions 3, 28 and 31

The majority of candidates gave the correct responses to these questions.

Question 4

A few realised that not all plant cells contain chloroplasts.

Question 5

While many appreciated that the colon is part of the digestive system, some opted for the larynx, trachea or ureter.

Question 6

Many candidates appreciated that the ink spread by diffusion. Some incorrectly believed that the process by which the ink spread was osmosis.

Question 7

The issue identified in **Question 6** (differentiating between diffusion and osmosis) was also apparent in this question, where not all were confident of the differences between the processes.

Question 8

Some candidates could recall the expected results of food tests but many could not.

Question 9

A few candidates could recall the basic units in the synthesis of oils.

Question 11

While many candidates appreciated that photosynthesis and respiration take place at the same time in pond weed, some thought that an animal needed to be present for respiration to occur.

Question 14

Many candidates were uncertain of the features of enzymes.

Question 15

While many understood that tooth decay is caused by the acid produced by bacteria, some believed that it was the bacteria themselves that digested the teeth.

Question 16

Some candidates appreciated that the blue dye will be transported in areas where the xylem is found.

Question 19

While many candidates selected the correct response some were less confident about the differences between arteries, veins and capillaries.

Question 20

Many candidates correctly identified the process as phagocytosis. The commonest incorrect response was antibody production. There were no antibodies indicated on the diagram.

Question 21

The approximate percentage of oxygen in expired air was not well-known.

Question 22

Some candidates appreciated that the roots will not have enough oxygen if they are underwater.

Question 23

This proved to be a challenging question for some with few selecting the correct response.

Question 24

Many candidates were able to identify the correct equation. The commonest misconceptions were that aerobic respiration would occur or that lactic acid would be produced.

Question 25

The fact that urea is excreted by humans was not well-known.

Question 26

A few candidates were able to recognise the location of the sensory neurone.

Question 27

Only a minority of candidates appreciated that light receptors are found in the retina.

Question 33

Many candidates were uncertain about this question, both in terms of the number of chromosomes found in gametes and how gametes compare to body cells.

Question 34

Although many candidates appreciated the definition of continuous variation, some believed that continuous variation results in a range of phenotypes with no intermediates.

Question 35

The conditions needed for evolution to occur were not well-understood by all.

Question 36

Most candidates gave the correct response. The commonest incorrect response was respiration.

Question 39

Many candidates understood what is involved in genetic engineering, with cross breeding being the most common incorrect responses.

BIOLOGY

Paper 0970/21
Multiple Choice (Extended)

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

General comments

The exam paper provided a good range of questions and challenge for candidates working at this level. Some candidates realised that not all plant cells contain chloroplasts. The concept of changing water potentials proved to be challenging for many candidates. Diffusion, osmosis, food tests, enzyme action, phagocytosis and the reflex arc were well understood by candidates.

Comments on specific questions

Question 2

Most candidates gave the correct response. Incorrect responses suggested that not all were certain of the difference between a genus and a species.

Question 4

Many candidates incorrectly believed that all plant cells contain chloroplasts.

Questions 6, 10, 12, 17, 20, 24, 29, 30, 31 and 40

The majority of candidates gave the correct responses to these questions.

Question 11

While most candidates answered correctly, some incorrectly thought that an animal needed to be present for respiration to occur.

Question 14

The concept of changing water potentials proved to be challenging for many.

Question 15

While many candidates appreciated the need for lipase to digest fats, some were not aware of the importance of bile.

Question 22

While many candidates appreciated that the plants die because the roots do not have enough oxygen, some incorrectly believed that the roots did not have enough water or that they had too much oxygen.

Question 26

Many candidates appreciated that there are three types of cones in the retina of a normal human eye. Some candidates incorrectly thought that rods are found in the fovea.

Question 32

The majority of candidates appreciated what would happen when a cell divides by mitosis. The commonest incorrect response was to select the daughter cell with half the chromosome number.

Question 36

While many candidates appreciated that it is respiration that releases carbon dioxide, some incorrectly believed that fossilisation releases carbon dioxide.

Question 37

Most candidates correctly identified the definition as a population. Community was the commonest incorrect response.

Question 38

Although most candidates appreciated that it is the plasmid that is particularly useful in genetic engineering, some candidates incorrectly opted for the strand of DNA.

Question 39

While many candidates appreciated that it is the 'taking wood from a woodland' that can be managed sustainably, some incorrectly opted for 'taking gas from under the earth's surface.'

BIOLOGY

Paper 0970/22
Multiple Choice (Extended)

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

General comments

The exam paper provided a good range of questions and challenge for candidates working at this level. Some candidates realised that not all plant cells contain chloroplasts. The concept of changing water potentials proved to be challenging for many candidates. The function of mitochondria; diffusion; osmosis; enzyme action; the effect of magnesium on plants; the distribution of xylem and the structure of veins; the role of the acrosome; the role of capillaries and energy losses along a food chain were well understood by candidates.

Comments on specific questions

Question 1

Many candidates selected the correct response. The commonest incorrect response was respiration.

Questions 3, 6, 7, 10, 12, 16, 17, 19, 20, 29, 30 and 37

The majority of candidates gave the correct responses to these questions.

Question 4

Many candidates incorrectly believed that all plant cells contain chloroplasts.

Question 5

Most candidates selected the correct value. The commonest incorrect response was 8.75 ∝m suggesting that not all were confident when converting millimetres to micrometres.

Question 11

The majority of candidates selected the correct response. Some candidates incorrectly thought that an animal needed to be present for respiration to occur.

Question 13

While many candidates correctly calculated the answer, some selected the value for 100 g fibre from the food label (2.8 g).

Question 14

The concept of changing water potentials proved to be challenging for many.

Question 22

While many candidates opted for the correct answer, a common error was to place the trachea before the larynx.

Question 23

Many candidates correctly worked out that 18 molecules of oxygen are required for the aerobic respiration of three molecules of glucose. The commonest incorrect response was to give the value for one molecule of glucose.

Question 25

This proved to be a challenging question with few able to identify the region that would have the highest protein concentration.

Question 27

Most candidates selected the correct response with only a few not appreciating how light affects the distribution of auxin.

Question 34

Many candidates appreciated that people who are heterozygous for the sickle-cell allele have a resistance to malaria. Some did not recall that genes are not of amino acids.

BIOLOGY

Paper 0970/31
Theory (Core)

Key messages

Command words such as 'describe', 'explain', 'suggest' and 'compare' require different responses. Candidates should be encouraged to identify the differences in the requirements for each command word and in particular the difference between 'explain' and 'describe' questions.

General comments

There were many excellent scripts showing that candidates had been well prepared.

Comments on specific questions

Question 1

(a) This question was answered well by the majority of candidates. The most common error was to match the function of the anther to the function of the stigma.

(b) This structure of pollen grains was well known and good responses were seen. Errors include responses that were not comparative but instead stated features of wind-pollinated and insect-pollinated pollen.

(c) Again responses were generally very good. The most common errors were the type of reproduction and the substances that were absorbed by roots.

Question 2

(a) Some candidates knew the features of arthropods with most giving the correct response the group with four pairs of legs. The other two characteristics were less well known.

(b) The majority of candidates gave correct responses. The commonest error was just to repeat the characteristics stated in **Question 2(a)**.

(c) **(i)** Many excellent responses were seen.

(ii) Most candidates gave the correct response. Occasionally the statement was the wrong way round i.e. as the rate of movement increases so temperature increases implying the rate of movement is causing an increase in temperature. Less well-executed response only quoted figures with no reference to the trend.

(iii) This proved to be a challenging question. A common incorrect response was (5÷9.5) · 100 = 52.6%.

Question 3

(a) The majority of candidates gave correct responses to this question. The most common errors were for the last part 'where the **most** water is absorbed'.

(b) **(i)** Some candidates gave the correct response. Many gave the type of disease rather than the type of pathogen.

(ii) A few knew the definition of the term. Common incorrect responses described the consequences of diarrhoea rather than what it was.

(iii) Some candidates gave a correct response.

(c) Generally well answered. The most common correct responses were skin and hairs in nose. Some incorrectly gave medical sources of protection such as vaccinations and antibiotics which did not answer the question.

Question 4

(a) Very well answered. The commonest incorrect response was to identify the vacuole as the nucleus.

(b) (i) As so many had got the first part of the question correct, candidates seem to be able to recognise cell structure, but fewer were able to describe the changes that had taken place in the cell. Many wrote about the cell contents going into the vacuole and others explained why this happened (answering part **(ii)** in part **(i)**). The most common responses were the vacuole and cytoplasm shrinking or reducing in size.

(ii) Generally not as well answered as the previous part. The best responses gave a good explanation using the term osmosis. Some answered part **(i)** in part **(ii)**. Some incorrectly wrote about the sugar solution moving rather than the water, others wrote about the water going in the wrong direction.

(iii) Most were able to understand that by placing the cell in water or a less concentrated solution, the cell could be returned to its original appearance.

(c) (i) Very well answered with the majority giving the correct response and very few stating phloem.

(ii) Again, generally well answered.

Question 5

(a) Many candidates knew that herbivores feed on plants or producers, fewer referred to energy.

(b) Increased food and decreased predation were the most common correct responses.

(c) Many good responses were seen. Some only described different forms of pollution and made no reference to overfishing, the effects on food chains or the extinction of species. Some gave reasons why the human population was increasing and many referred to deforestation which did not answer the question.

Question 6

(a) The majority of candidates gave the correct responses. Common incorrect responses included sperm duct, oviduct and ovules.

(b) (i) Again well answered by the majority of candidates. The commonest incorrect responses were embryo or fetus instead of zygote and ovule instead of ovum.

(ii) Only a few candidates gave the correct responses. Some gave XX or XY for the gametes and some did not realise that the embryo was female and gave XY for the zygote. A few gave a numerical value.

(iii) Most candidates identified fertilisation but fewer identified mitosis.

(iv) Most correctly gave uterus. A few stated placenta.

(c) Most candidates knew examples of barrier and chemical methods of contraception but fewer were able to give examples of surgical and natural methods of contraception.

Question 7

(a) Well answered by the majority of candidates.

(b) (i) Well answered.

(ii) Very well answered.

Question 8

This proved to be a challenging question for many. A common error was to state the phenotypes rather than the genotypes.

BIOLOGY

Paper 0970/41
Theory (Extended)

Key messages

It is important to:

- Use the mark allocation and number of answer lines as a guide as to how much information to include in each answer.
- Choose key data points from graphs to use in answers rather than points chosen at random.
- Use comparative words, such as higher, lower, greater, smaller, longer, shorter, heavier and lighter, when identifying differences between trends shown on graphs or data presented in tables.
- If bullet points are used on long answer questions ensure that each point is sufficiently detailed to gain the marks.
- Look at the marks in square brackets on each page to ensure that each question has been answered, even those that do not have answer lines or spaces to write in.

General comments

Candidates seemed to find questions set in unfamiliar contexts more challenging.

Candidates should be advised to read carefully all the information in each question before attempting to write any answers. Often careful reading gives help in deciding which topic is being tested. Many marking points can be gained simply by interpreting and applying this information when constructing an answer. There is no need to write out the information in the questions. In **Question 3(c)** less well-executed responses restated the information provided in Table 3.1 rather than applying it to the question. In **Question 5(b)(v)**, candidates wrote about 'mRNA leaving the nucleus of the bacterium' suggesting that they had not realised that features of bacterial cells were relevant to this question.

Candidates should be encouraged to plan longer-response answers carefully before they begin writing. Some good responses to **Question 3(c)** included plans in the margin or on blank pages. As a result responses tended to be coherent and detailed.

Many answers to **Question 2(c)(ii)** were straightforward descriptions that gained full credit. Some candidates used up time by writing explanations that were not required. The graphs in **Question 2** provide useful examples for future candidates to practice describing graphs with key data points used in support. It was clear from answers to this question that some found analysing graphs challenging. In **Question 2(c)(iv)** not all were confident with using the term limiting factor in their answers. Many were of the firm opinion that temperature and carbon dioxide were not limiting factors because the rate of photosynthesis increased across the whole range of temperatures investigated. In fact it is because the rate increased that temperature is the limiting factor in this case.

If a question asks for a single response or for a certain number of responses, then nothing is gained by giving more responses than requested. Correct answers will not be selected from a list of incorrect answers as the first responses only will be considered.

<u>Comments on specific questions</u>

Question 1

(a) A surprising number of candidates did not appear to know the definition of the term *species* as given in the syllabus. Many candidates stated that all the organisms in a species share the same characteristics or gave the definition for a population. There were many answers that referred to the classification system identifying species as the 'last group' or as a 'sub-group of a genus' or explaining how they are named using the binomial system. Some also referred to geographical distribution or shared habitat as the reason for organisms being in the same species. A number of candidates used the term 'animals' rather than organisms therefore excluding plant, fungal or bacterial species.

(b) Many candidates gave two correct responses. Features that do not distinguish mammals from all other vertebrates were not accepted.

(c) There were many excellent accounts of selective breeding that made good use of the example given in the question. The majority of candidates described the early stages of the breeding programme by referring to the selection of the sheep to use for the first cross. Some candidates did not continue the process of selection and breeding, but those that did often simply referred to breeding using the first generation and did not state that this process of selection and breeding would continue for future generations. Very few referred to measuring the hairs or assessing their quality in all the offspring before making the selection. Less well-executed responses often included irrelevant detail about how the sheep would be looked after, such as providing them with food and water. Some gave descriptions of genetic engineering or cloning which did not gain credit beyond the selection of appropriate animals as the source of the gene or genes to use. Some thought this was a question on genetic crosses and wrote about sheep that were homozygous and heterozygous for thin hair.

(d) Candidates were less sure about the differences between natural selection and selective breeding. Few stated clearly that environmental factors are responsible for natural selection and very few referred to the role of competition in the process. Many referred to 'fitness' as in 'survival of the fittest' without realising that the syllabus defines fitness as 'the probability of an organism surviving and reproducing in the environment in which it is found'. Good responses referred to the greater range of variation that tends to result from natural selection rather than selective breeding, and the difference in timescales.

Question 2

(a) There were many good responses to this question. Candidates often stated that carbon dioxide is used in photosynthesis to make glucose. Good responses stated that carbon dioxide is a raw material for photosynthesis and reacts with water to form glucose. A few described the production of carbon dioxide in respiration.

(b) Many candidates appeared not to appreciate that they were being asked how they would *calculate* the rate of photosynthesis. Good responses stated that the difference between the concentrations of carbon dioxide entering and leaving would be found, and then divided by time. One error was to answer in the context of the machine measuring oxygen concentration. A large number simply related the concentration of carbon dioxide measured by the apparatus to the rate of photosynthesis without explaining how the rate could be calculated. It was rare to see any consideration given to the respiratory behaviour of the leaf since carbon dioxide produced by respiration is used in photosynthesis.

(c) **(i)** Light intensity and humidity were the most common correct answers to this question. A surprising number gave carbon dioxide concentration or temperature even though these factors are given in the question. Some referred only to light rather than light intensity.

(ii) Many good descriptions were seen. These answers described the trend accurately, referred to the key temperature of 30 °C and used at least two rates of photosynthesis taken from the graph correctly. In the main candidates were careful to quote values from the graph accurately with the unit for rate transcribed in full. The most common error was omitting 'per second' from the unit.

(iii) Some candidates calculated the percentage increase correctly. Some misread the figures from the graph, others calculated the increase in rate as a percentage of the rate at **B** rather than at **A**. Many did not round their answer to the nearest whole number as required by the question.

(iv) Some candidates gave correct responses to this question but it was apparent that not all were confident of the meaning of the term limiting factor. Most concentrated on applying the concept of a limiting factor without explaining how an increase in temperature leads to an increase in the rate of photosynthesis. Few answers explained the effect of temperature in terms of enzyme activity or diffusion of carbon dioxide into the leaves. Fewer related what was happening to more carbon dioxide being fixed or used. Many described the relationship shown by line **B** on Fig. 2.2 and then stated that temperature is **not** the limiting factor and often stated that carbon dioxide is the limiting factor rather than the other way around. Some stated that there were no limiting factors at all.

(v) In this question many candidates simply stated the results shown for line **A** on Fig. 2.2 without pointing out that when the carbon dioxide concentration is increased in **B** the rate of photosynthesis is higher. The best responses stated that the rate is higher at all temperatures.

(d) This question was answered well by many candidates. Unlike part **(c)(iv)** this question tended to prompt answers about enzymes. Many candidates predicted that the rate of photosynthesis would decrease or remain constant and explained this in terms of denaturation of enzymes.

Question 3

(a) Many candidates completed the passage on the nervous system correctly. Those who did not tended to know at least the last two terms and made a recognisable attempt at spelling peripheral. Accommodation and antagonistic were the terms that were least well known with 'focusing' and 'opposing' being common incorrect answers. Quite a few candidates gave 'central' rather than 'peripheral' for the third response.

(b) There were many excellent answers to this question. Some candidates did not consider the context of this question and instead of writing about the movement of ions explained how neurotransmitters are released and cross synaptic gaps. Many candidates stated that ions move down a concentration gradient in active transport rather than against the gradient. Some stated that the ions move by diffusion and many contradicted themselves by stating that ions move from a low to a high concentration down a concentration gradient. There were many good references to protein carriers and the way they move ions across membranes by changing shape.

(c) Some candidates found this question challenging. Many answers assumed that the question asked for the effects of the two drugs when taken *together*. Even when writing about atropine and eserine separately many thought that they both inhibit transmission of impulses across synapses. There were, however, some excellent explanations of the inhibitory action of atropine that clearly relied on a good knowledge of synaptic transmission. Some did not realise that inhibition of the enzyme by eserine leads to an accumulation of neurotransmitter and therefore continuous stimulation of the postsynaptic neurone. Many candidates describing eserine had the incorrect idea that the neurotransmitter had to be broken down in order to bind to receptors. Some ignored the information provided in the question and wrote about the action of other drugs, such as heroin.

(d) There were many good discussions of the arguments against the use of anabolic steroids in sport. Many listed side effects of these drugs. Some stated that use of these drugs is banned in sport but did not consider what happens to athletes found using them. In general, there was a tendency for most candidates to concentrate on one aspect of drug use in sport, such as listing side effects, without considering different aspects of the issue.

Question 4

(a) Although there were many answers that gave correct matches, there were many that did not. Common errors included the matching of the epithelium and the nucleus with the cell. A significant number identified sperm as an organism.

(b) Most completed the first two rows correctly, but then misspelt urethra in row 3, identified **F** rather than **E** as the prostate gland in row 4 and did not name the scrotum in the final row. The prostate was often linked to the formation of sperm rather than seminal fluid and some thought it was involved in urination. The sperm duct (**D**) was often referred to as the 'seminal tubule'. A number of candidates confused the male reproductive system with the female as they named organs such as oviduct and uterus when completing the table.

(c) Most of the candidates who attempted this question placed an **X** in the appropriate organ or used a label line. Common errors were to put the **X** in the epididymis, prostate gland or bladder.

(d) (i) The majority of candidates gave the correct definition.

(ii) Almost all candidates gave the correct value. Common incorrect answers were 24 and 46.

Question 5

(a) (i) Many candidates defined the term *plasma* correctly. Some confused plasma with cytoplasm saying that it is the fluid inside cells. Some defined plasma as a fluid but without any reference to blood or stated that it was a type of blood cell.

(ii) Many candidates gave the correct response. 'Fibrinogen' and 'mesh' were common incorrect answers.

(b) (i) Structure **A** on Fig. 5.1 was identified correctly as a plasmid by many candidates. A common error was to identify **A** as a cell wall, which may have indicated some confusion that the structure was in fact an entire bacterium. If so, candidates had not realised the purpose of the arrow immediately above **A** in Fig. 5.1.

(ii) Many candidates identified the enzyme that acts on DNA as a protease. There were, however, many who stated correctly that the enzyme is a restriction enzyme. Many gave words that began with 'restrict' such as 'restrictive'. This and other spellings that began with 'restrict' were credited.

(iii) Some candidates used the information given in Fig. 5.1 to write excellent accounts of how the *TPA* gene is inserted into the plasmid to make the recombinant plasmid. The best answers made it clear that the *same* restriction enzyme must be used to open the plasmid as was used to cut the *TPA* gene from human DNA. Many stated that sticky ends are produced and that ligase is used to attach these ends. Some candidates stated that the base sequences of the sticky ends are complementary, although some stated that sticky ends have complementary shapes rather than base sequences. The base sequences are complementary because the same restriction enzyme was used to cut human DNA and plasmid DNA.

(iv) There were many good suggestions for the advantages of producing the protein TPA by genetically-engineered bacteria. Some, however, referred to matching blood groups and avoiding rejection. Neither of these suggestions are appropriate to this example. Many gained credit because they stated that bacteria can reproduce very fast or that there is a reliable supply of TPA that does not depend on blood donations.

(v) Many candidates knew the role of mRNA, although they often forgot that this question is about bacteria, which do not have nuclei. Most candidates were able to link the mRNA to protein synthesis. The role of the ribosome in protein synthesis was well known. Some referred to mRNA being a code that forms amino acids rather than having a sequence of bases that codes for the order in which amino acids are assembled to make a protein.

Question 6

(a) (i) The most common reason for identifying these cells as plant cells was the presence of a cell wall, the regular shape of the cells and the presence of vacuoles. Many candidates stated that they could see chloroplasts. There are none visible in the micrograph, but since these are cells from a plant shoot they might be expected to have chloroplasts and be photosynthetic, so the answer 'chloroplasts' was ignored rather than being counted as incorrect. 'Chlorophyll' was also seen on scripts. Even if chloroplasts had been present in the image this would have been incorrect as it is not a structure that is visible in images of plants cells.

(ii) The majority of candidates gave a correct response.

(b) Many candidates gave excellent answers to this question. Many stated that mitochondria carry out aerobic respiration to release energy or to produce ATP. One misconception was that mitochondria ‘produce’ energy rather than releasing energy. Fewer candidates identified a process that occurs during cell division that requires energy, such as the production of DNA for the new cells.

(c) **(i)** Auxin was named correctly on most scripts. ‘Axon’ was the most common incorrect response.

(ii) Well-prepared candidates wrote very good answers that included the production of auxin in the shoot tip and its movement down the stem to stimulate cell elongation or growth of the shoot. These good answers also stated that if the plant was on its side auxin collects on the lower side of the stem so that there is unequal cell elongation and the stem grows upwards. Many candidates stated that this is negative gravitropism (or geotropism). Less well-executed responses included details of the response to light rather than gravity. Some gave contradictory answers which had shoots as both positively and negatively gravitropic and some wrote reasonable responses about the effect of auxin on root tissues and identified these as positively gravitropic, however this did not answer the question asked. Some misunderstood the question and wrote about how a clinostat or similar piece of apparatus could be used to 'control' the response of the shoot.

(d) This proved to be a challenging question. Many candidates realised that cells have different functions. Some used the clues in the earlier parts of **Question 6** to state that genes code for proteins and not all cells require the same proteins. Most candidates related genes to characteristics and cell organelles rather than to proteins. Some suggested that it would be a waste of energy and resources if all the proteins coded by all the genes in a cell were made. Many thought that different cells have different genes. Some thought that genes are not expressed because they have mutated.

BIOLOGY

Paper 0970/42
Theory (Extended)

Key messages

It is important to:

- Use the mark allocation and number of answer lines as a guide as to how much information to include in each answer.
- Choose key data points from graphs to use in answers rather than points chosen at random.
- Use comparative words, such as higher, lower, greater, smaller, longer, shorter, heavier and lighter, when identifying differences between trends shown on graphs or data presented in tables.
- If bullet points are used on long answer questions ensure that each point is sufficiently detailed to gain the marks.
- Look at the marks in square brackets on each page to ensure that each question has been answered, even those that do not have answer lines or spaces to write in.

General comments

Although candidates were generally well-prepared to answer questions on the entire syllabus, there was some evidence that some were unfamiliar with the effect of increased carbon dioxide concentration on breathing rate.

Comments on specific questions

Question 1

(a) Almost all candidates stated the correct organism. The most common errors were bacteria, microorganisms and enzymes.

(b) (i) Most candidates knew the source of energy used by the yeast. Less common incorrect responses included 'heat' or 'sunlight' as the source of energy.

(ii) Many candidates gave the correct response.

(iii) Almost all candidates gave the correct response.

(c) Some very detailed explanations for the reasons that different temperatures were used at steps 3 and 5 in the flow diagram were seen.

(d) A wide range of examples of products formed from biotechnology were seen. Common examples included alcohol, beer, wine, yoghurt, insulin, penicillin and cheese.

Question 2

(a) The majority of candidates gave good descriptions. A common error was to write about global warming more generally and include reasons for the increases in the concentration of other greenhouse gases, such as methane.

(b) Many candidates gave very detailed descriptions. Most included relevant explanations for the trends that they described. Some did not see the significance of light in photosynthesis. A few made comparative statements on the data but did not include the units. Many stated that a higher concentration of carbon dioxide meant more photosynthesis, but did not explain why.

(c) This question was well-answered by the majority of candidates. Common misconceptions included stating that the cuticle was a tissue. Many correctly identified features such as 'more chloroplasts' or 'tightly packed' but did not to link it to more light.

(d) This proved to be a challenging question. Many thought that if the carbon dioxide concentration was high, the oxygen concentration would be low and gave an explanation in terms of lack of oxygen.

Question 3

(a) (i) Many candidates gave the correct value and most also remembered to include the units.

(ii) Almost all candidates gave a correct recommendation.

(b) (i) Many candidates constructed a suitable food chain. A common error was to include sand at the start of the food chain. A few drew arrows that pointed in the wrong direction and some of drew lines connecting the organisms with no indication of direction.

(ii) Most candidates interpreted the table of data correctly and provided good descriptions. Fewer were able to explain the data successfully.

(c) (i) Some candidates showed a good knowledge of the nitrogen cycle and gave the correct response.

(ii) Some candidates gave the correct process.

(iii) Most candidates explained that nitrate ions would be used to make amino acids and proteins in plants. Better responses explained that protein was needed for growth.

(d) Some excellent and very detailed responses were seen. It was evident that many candidates were unfamiliar with the term 'terrestrial', even though it is in the syllabus, and described the effects on marine environments instead.

Question 4

(a) (i) Many candidates gave excellent descriptions. A common error was to describe how neurones differ from each other but this did not answer the question.

(ii) Most candidates gave the correct response.

(b) (i) Fewer candidates were able to describe the pathway in a reflex arc in response to shining a bright light into the eye. The pathway along sensory, relay and motor neurones was well known. Fewer were able to correctly describe the receptors or the effectors in this reflex arc.

(ii) Many candidates gave a correct response. The most common correct answers included automatic, involuntary and not requiring thought.

(c) (i) Many candidates correctly named the parts of the synapse.

(ii) Most candidates indicated the direction in which a signal would travel across a synapse.

Question 5

(a) (i) Almost all candidates knew that testosterone is released from the testes.

(ii) Most candidates named at least one organ and corresponding organ system, but fewer were able to complete the diagram with two sets of correct pairings.

(b) Many candidates were familiar with meiosis, but fewer were able to apply their knowledge to explain why this process is necessary in the testes. Some candidates explained that the testes produce gametes that are needed for sexual reproduction. A few stated that meiosis is a division of the sperm instead of a division of nuclei that occurs in the production of sperm.

(c) Most candidates identified and labelled at least one structure on the image of a sperm. The most common correct features were the flagellum and the mitochondria. Fewer identified the acrosome or stated the correct function of the haploid nucleus. Many knew that the haploid nucleus contains chromosomes but did not qualify their statement further to distinguish it from a diploid nucleus.

(d) Many excellent labelled drawings were seen. A common error was to omit the labelling of one of the features of the egg cell.

(e) Most candidates described the sequence of events that occurs between the fertilisation of an egg and implantation. The term zygote was known by many but its position in the sequence of events was not always correct.

Question 6

(a) Most candidates gave the definition of a species from the syllabus, but some only gave a partial definition suggesting only that species have many common characteristics.

(b) Many candidates knew the advantages of asexual reproduction, but some did not consider the context of crop production in their answers. Most knew that the process only involved one parent, that it was a faster process and resulted in genetically identical offspring, but many did not apply their knowledge to this specific context.

(c) Most candidates knew that starch was stored as an energy store but fewer went on to explain why it was necessary.

BIOLOGY

Paper 0970/51
Practical Test

Key messages

- Candidates must ensure that they read and fully understand the questions 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.
- Candidates must be familiar with the practical procedures indicated in the syllabus. This means that candidates are expected to be able to carry out these procedures safely, but also that they should be able to work with competence on practical procedures that derive from learned methods.
- 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. Candidates are encouraged to show all stages of their working.

General comments

Candidates performed well on the majority of the paper, with most candidates apparently confident with the practical procedure and manipulation of equipment. It was evident that an increasing number of candidates show an understanding of the expectations of the mark scheme.

A small number of candidates found the planning exercises challenging, but the majority were able to produce well thought-out logical investigations. Identification of variables, safety and a workable method are key aspects of this task.

Graph drawing was a skill that most candidates continue to perform well on, with well-produced graphs and neat lines. Few candidates plotted bars incorrectly or used an inappropriate scale for the axes of their graph. Similarly, drawing of a table for data also posed few problems for the majority of candidates, with underlined headings and units.

The drawing skill remains a challenge for a number of candidates. The instructions need to be read carefully and drawings must be neat, in proportion, and show sufficient detail.

Comments on Specific Questions

Question 1

(a)(i) Most candidates were able to describe the agar, usually with a colour change stated. Any other descriptions or unusual colours were accepted in accordance with the Supervisor's Report. Measurement of distances was not required for this question.

(a)(ii) The most common error was to describe only a starting point for the measurement rather than describing where the measurement was taken from and where the measurement ended. Some answers also lacked detail, for example by describing 'the circle' which could have meant either the Petri dish or the area of colour change.

(a)(iii) Most of the tables of results were well presented with suitable headings and units. A common error was to put units in the body of the table with the data rather than in the heading only.

(a)(iv) Almost all candidates correctly described the relationship between the two variables.

(a)(v) The majority of candidates correctly calculated the diffusion coefficient. The most common error was to forget to square the value of 14, or to convert 30 minutes to seconds. It is important that candidates understand the difference between significant figures and decimal places.

(b)(i) Most candidates could easily identify at least one variable that had been kept constant, with common answers being number of drops and temperature. A few candidates referred to the concentration of citric acid which was the independent variable.

(b)(ii) Although a number of candidates correctly identified one possible source of error in the investigation, far fewer were able to suggest how this might affect the results (area of diffusion).

(c) The planning exercise was particularly well done this year. Most recognised that temperature was the independent variable and chose at least three suitable values below 70 °C (although a few misunderstood the information given and assumed that the experiment would only work at temperatures above 70 °C).

Some variables that were to be kept constant were identified, but relatively few identified that the concentration of citric acid had to remain constant which was a key change from the method used in the practical work.

Question 2

(a)(i) Most candidates produced a suitable drawing. The quality of drawings was reasonable and most were drawn to a good size. The commonest error was to include cells as part of their drawing. Candidates should always use a sharp pencil when drawing.

(a)(ii) The calculation of actual size was well done, with the majority of candidates correctly substituting in the relevant values and rearranging the equation. A minority forgot to include the unit for their measurement.

(a)(iii) Only a few candidates correctly identified the position of the type of cells shown, with many labelling the palisade layer. Some labelled Fig. 2.1 or Fig. 2.2 instead of their drawing as instructed.

(b)(i) The best responses were precise; many responses were too general and did not relate specifically to the context of the investigation. Many referred to an increase in accuracy rather than the idea of being able to identify anomalous results if large amounts of data are collected.

(b)(ii) Some candidates appreciated the value of randomly selecting leaves to avoid bias.

(b)(iii) Most candidates had some idea of a suitable method. A common error was to describe putting the leaf on a grid and then counting squares. In reality this would not work as the grid would be covered by the leaf and so would not be visible. Using a transparent grid to cover the leaf was accepted as were any other methods that would result in a correct estimate.

(b)(iv) Almost all candidates correctly identified the independent variable.

(c)(i) Candidates found the percentage increase calculation challenging. Many tried to calculate percentage decrease or simply calculated the difference between the two values.

(c)(ii) The graph was reasonably well done by most candidates. Some plotted a line graph despite being asked for a bar chart, but nearly all managed to plot all of the points accurately.

(c)(iii) A great number of candidates compared species **A** with species **B** rather than describing the trend for each. It should also be noted that candidates should not jump to the conclusion that one out of three points is an anomaly if it varies from the others.

(c)(iv) Although many candidates identified that more points needed to be taken, few then went on to say where the points should be (i.e. around the value that gave the largest leaf area).

BIOLOGY

Paper 0970/61
Alternative to Practical

Key messages

It is important that candidates read each question carefully so that they answer the question asked.

Candidates need to show their working in the calculations. Often a final answer may be incorrect, but a correct intermediate stage may be worthy of a mark. It is important that candidates understand the difference between significant figures, decimal places and whole numbers.

General comments

There were some excellent scripts showing that these candidates had a comprehensive grasp of the subject.

There is clear evidence that teachers are addressing areas pinpointed in the past as needing attention.

Comments on specific questions

Question 1

(a) (i) Almost every candidate constructed the table adequately. Common errors included incomplete headings and writing the units in the body of the table with the data. Most candidates measured the distances accurately but some used units that did not match their measurements.

(ii) There were some excellent answers with candidates stating clearly where their measurements started and ended. Other candidates had difficulty expressing their answers and gave long complicated descriptions often involving theoretical references to diffusion which was not required.

(iii) This question was well answered by the majority of candidates. Most could state the relationship that the higher the concentration of citric acid, the further or faster it diffused.

(iv) The majority of candidates could carry out the substitution and calculate the diffusion co-efficient. A significant number did not follow the instruction to give their answer to two significant figures.

(v) The pH values for Universal Indicator were well-known.

(b) (i) Most candidates could state at least one variable that had been kept constant. A few candidates referred to the concentration of citric acid which was the independent variable.

(ii) Most could identify an error, usually that drop size from the pipette would vary or that the use of one pipette would lead to contamination. Fewer described the effect that this would have on the results. Many just stated that the results would be inaccurate which was not sufficiently detailed. Some suggested improvements which would eliminate the error which did not answer the question.

(c) There were some excellent accounts of how to adapt the investigation to find the effect of temperature on diffusion. Some wrote theoretical accounts of the effect of temperature on diffusion rates which did not answer the question. A few had focussed on that fact that agar melts at 70 °C but rather than using temperatures lower than 70 °C had either investigated the melting point of agar or planned an investigation into the rates of diffusion in liquid agar. Of the candidates who adapted the original method, most realised that the concentration of citric acid had to be kept constant.

Question 2

(a) **(i)** Five hand-drawn horizontal lines to show the tissue layers in the correct proportions were required. Labels were not required, though frequently given.

Many candidates disregarded the instruction not to draw cells and spent a considerable amount of time drawing every cell. Most drawings were of a suitable size with correct proportions for the tissue layers. Some drawings were of adequate height but too narrow. The drawing was expected to be at least as a large as the photomicrograph.

(ii) The majority of candidates measured accurately and carried out the calculation correctly. Common errors arose when changing units during the calculation but not changing the unit in the answer; multiplying by 100 instead of dividing by 100 and dividing their measurement by another number (possibly the measurement from their drawn diagram).

(iii) Many candidates recognised the cell type and located its position accurately on their drawing.

(b) **(i)** Many candidates gave a suitable response. One misconception was that accuracy would be improved, but this term is not applicable here. Another misconception was that it would prevent anomalies occurring. Some appeared to have misread the question and explained why large leaves were collected.

(ii) Some candidates could explain why leaves were selected at random. Avoiding bias was the most frequently stated acceptable answer.

(iii) Many candidates gave a suitable method. The majority of candidates who placed the leaf on the grid forgot to say that the leaf shape was drawn onto the grid. One misconception was that you would be able to calculate the area of the leaf by measuring its length and width only, as leaves are not a uniform shape this would not work.

(iv) The majority of candidates knew that light intensity was the independent variable.

(c) **(i)** Candidates found the percentage increase calculation challenging. Many tried to calculate the percentage decrease or simply calculated the difference between the two values. Relatively few rounded their answers to a whole number as instructed.

(ii) Some excellent bar charts were produced although some found this task challenging. Common errors included: omitting the units when labelling the axes, selecting an unequal scale for light intensity and transposing the readings for 0 au and 100 au.

The plotting of the bars was usually accurate and bars were normally of equal width and with gaps between bars or between groups of bars.

(iii) The majority of candidates could give the trend for species **A**. Fewer described the trend for species **B**. Some candidates described the results rather than the trends which did not answer the question.

(iv) Although many candidates identified that more points needed to be taken, few then went on to say where the points should be (i.e. around the value that gave the largest leaf area).

BIOLOGY

Paper 0970/62
Alternative to Practical

Key messages

When planning an investigation, candidates should take care to fully describe which variable is being changed, which is being measured and how, as well as which variables need to be kept constant and how that will be achieved.

When drawing graphs thought needs to be given to which scale to use to ensure the data points cover more than half the grid in both directions.

When drawing biological specimens care needs to be taken to include detail, without the use of shading. Drawings should be drawn freehand without the aid of a ruler or compass.

General comments

Candidates were well-prepared for the exam and demonstrated a very good understanding of the practical procedures outlined in the syllabus.

Most candidates had developed good skills in drawing tables, graphs and biological specimens.

Many were good at identifying errors in methodology and how the investigation could be improved.

Comments on specific questions

Question 1

(a) (i) Most candidates drew a table, with appropriate headings and times converted to seconds. Those candidates that lost a mark usually did so because they put the units for time (s) into the data cells, or they omitted a heading for the independent variable.

(ii) Nearly all candidates were able to interpret the results and give a correct conclusion referring usually to the methylene blue dye becoming colourless more quickly in the warm temperature than the cool temperature. Those that did not get a mark had usually restated the results rather than giving a conclusion.

(iii) The vast majority of candidates completed the temperature table correctly.

(iv) Nearly all candidates knew that the variable that was changed in the investigation was temperature. The most common error was to give time or test-tube as the variable that was changed.

(v) With this type of question candidates must make sure that they qualify their answers. For example, ‘layer of oil’ is not sufficient whereas ‘depth of the layer of oil’ would be accepted.

(b) (i) Candidates should be familiar with identifying common errors in experimental methodology. Many candidates identified the error correctly and offered a suitable improvement. Some did not give an error that related to step 6 which did not answer the question.

(ii) This question was generally answered well with a lot of candidates using the data to recognise that the temperature had not been maintained and that a thermostatically controlled water-bath or insulated beaker should be used. Some did not give enough detail for the improvement and just mentioned that a water-bath should be used. A common error was to say that there had been an error with the use of the thermometers, or that thermometers should be used to control, rather than to monitor, the temperature. Some thought the error was that the temperature should have decreased by the same amount in each test tube.

(c) The vast majority of candidates gave a suitable indicator and result. Common errors were soda lime, lime and the use of a lighted splint.

(d) A range of answers were seen for this question. Candidates should understand the difference between concentration and volume. Some confused the two and planned to use different volumes of ethanol rather than different concentrations. Only a few gave correct units for concentration. Often candidates just repeated the question stem and said use different concentrations of ethanol but without qualification .The variables that should be kept constant were often correctly identified and most could identify the dependent variable. A few did correctly refer to allowing the test-tubes to equilibrate at a set temperature before adding the indicator but sometimes this was mentioned after the ethanol was added .Some also thought they had to vary the volume of yeast to change the ethanol concentration. When planning investigations candidates should consider which variables should be kept constant and which are being changed (independent variable) and measured (dependent variable). Candidates should ensure the safety measures they propose are relevant to the specific investigation being described, and avoid generic statements of laboratory safety protocol.

Question 2

(a) (i) Drawings of differing quality were seen but the majority were good. Nearly all were an acceptable size and had a good level of detail drawn. Care needs to be taken with the outline. Lines should be clear and continuous with no overlaps and should be drawn freehand without the use of a compass or ruler. Drawings should not be shaded. Candidates should be encouraged to carefully observe details such as the numbers and relative size and proportions of the shapes of the structures in their drawings. They should also ensure drawings do not overlap into any of the margins or onto the writing on the question paper.

(ii) The majority of candidates were able to accurately measure **PQ** line. Those who measured in millimetres seemed to find it easier to calculate the correct value. Those who used both centimetres and millimetres in the calculation had a higher chance of error and often did not round their final answer to a whole number as instructed.

(b) (i) Nearly all candidates correctly calculated the percentage of seeds that germinated at pH8.

(ii) Some very good line graphs were seen with axes labelled correctly and points plotted accurately. The most common error was to use a scale that was too small so that the plots did not cover at least half the grid in both directions or to use a non-linear or unequal scale. Another error was to extrapolate the line beyond the first or last data points. A few misread the question and plotted number of seeds that germinated against the percentage of seeds that germinated.

(iii) Some good descriptions of the trend were given. However, some only mentioned the peak at pH6 and not the trend before and after.

(b) (iv) Although many candidates identified that more measurements needed to be taken, few then went on to say which pH values should be used.

(c) Most candidates knew the test for reducing sugars. The commonest error was to omit the heating step.