

BIOLOGY

Paper 0610/11
Multiple Choice (Core)

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

General comments

There was a good understanding of the characteristics of living organisms, the role of enzymes, the effect of hormones, and ecological pyramids.

Candidates should be able to use descriptions of terms in the syllabus such as transpiration and gene.

Candidates need to consider all the information presented in a question and read each option (for example **Questions 5, 8 and 17**) and interpret diagrams carefully (such as in **Questions 21, 25 and 33**).

Comments on specific questions

Question 5

Many candidates incorrectly thought that root cortex cells absorb mineral ions from the soil, which is the function of root hair cells.

Question 8

Many candidates were unable to interpret the results of the tests for biological molecules correctly. Candidates should be able to recall the colours of both negative and positive tests.

Question 13

Although many candidates knew that either calcium or vitamin D prevent rickets only a minority knew that both do. Candidates should be able to describe the causes of rickets and the importance of each component of a balanced diet.

Question 17

Few candidates could fully identify the correct processes for transpiration, with many confusing evaporation and diffusion.

Question 18

Most candidates were unable to put the heart and blood vessels in the correct order.

Question 21

Some candidates could relate the production of gas to anaerobic respiration occurring in the yeast and then identify the correct equation. A few confused this with the equation for photosynthesis or anaerobic respiration in muscles.

Question 25

Only a few candidates could identify this example as asexual reproduction.

Question 29

Although many candidates knew that the infection that can lead to AIDS is caused by a virus, some incorrectly thought it was caused by a bacterium.

Question 33

Most candidates were able to interpret the graph correctly, although a minority incorrectly thought that the graph showed continuous variation.

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Paper 0610/12
Multiple Choice (Core)

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

General comments

There was a good understanding of the characteristics of living organisms, magnification, enzymes, the function of red blood cells, the role of adrenaline, methods of HIV transmission, and energy transfer.

Candidates should be able to use descriptions of terms in the syllabus, such as cell, organ, tissue, and gene.

Candidates need to read the questions carefully (for example **Questions 6, 19 and 29**) and interpret graphs precisely (such as in **Question 36**).

Comments on specific questions

Question 11

Most candidates could not link the low pH in the stomach to a peak in enzyme activity at a low pH.

Question 18

Candidates were confused between urethra and ureter, with only a small proportion selecting the correct answer, option **D**.

Question 23

A few candidates did not understand that oxygen is a requirement for germination.

Question 25

A common misconception was that fertilisation occurs in the uterus or in the ovary.

Question 29

Many candidates were unable to work out the expected phenotypic ratio with the majority thinking it gave a 3:1 ratio. This suggests that the candidates had not read the question carefully enough.

Question 30

Although the most common answer was the correct answer, option **D**, many candidates could not correctly identify the type of variation with a correct example.

Question 33

Few candidates could apply the description of a food chain to the correct pyramid of numbers despite values being given in the question.

Question 35

Many candidates were unclear on the sequence of stages in the sigmoid population growth curve. The most common error was switching the lag and log phases.

Question 36

Although many candidates understood that the carnivore population would decrease, some did not read the graph carefully and so had the population decreasing before time X.

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Paper 0610/13
Multiple Choice (Core)

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

General comments

There was a good understanding of the characteristics of living organisms, the digestive system, asexual reproduction, and water pollution.

Candidates need to consider all the information provided in diagrams (such as **Questions 20** and **23**) and read the questions carefully (such as **Questions 18** and **32**).

Comments on specific questions

Question 4

Some candidates could identify the description of the plasmid correctly; the commonest wrong answer was the description of blood plasma.

Question 7

Many, but not all candidates could identify which factor reduces the rate of diffusion.

Question 16

A significant proportion of candidates thought that transmission of disease by touching contaminated surfaces was direct contact.

Question 21

Candidates were unclear about the role of structures in the eye with only a small number identifying the cornea as the structure that refracts light as it enters the eye. Many candidates incorrectly selected the pupil, perhaps confusing the amount of light entering the eye with the direction of light.

Question 23

Many candidates could not distinguish correctly between growing towards and growing away from a stimulus.

Question 28

Many candidates did not know that the prostate gland produces seminal fluid.

Question 32

Most candidates were unable to work out the genotypes of the parents with a majority selecting option B. This would give red flowered parents but no white flowered offspring and so does not fit the described cross.

Question 33

A common misconception was that hazel trees are the source of energy of this food chain with a majority of candidates not realising that the Sun is the source of energy for the hazel trees.

Question 35

Many candidates confused the lag phase which occurs before the exponential (log) phase with the stationary phase which occurs afterwards.

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Paper 0610/21
Multiple Choice (Extended)

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

General comments

There was a good understanding of the characteristics of living organisms, plant cell structure, the effect of temperature on enzyme-controlled reactions, double circulatory systems, and sources of genetic variation.

Candidates are expected to be able to describe key terms in the syllabus such as deamination and active transport.

Candidates need to read all the information provided in the questions (for example **Question 14, 20 and 38**) and interpret diagrams carefully (such as in **Questions 5, 25 and 40**).

Comments on specific questions

Question 4

Many candidates could not convert values in cm to μm .

Question 6

The majority of candidates knew that active transport is the movement of substances against a concentration gradient, but few realised that it also requires a partially permeable membrane.

Question 13

There was some confusion about whether flowers are sinks, with some candidates incorrectly thinking they are sources.

Question 14

Candidates are reminded to read the question carefully, here few identified option **D** as the correct answer. The commonest incorrect response was option **B**, statement 1 is incorrect because it is fibrinogen that is converted to fibrin to form a mesh.

Question 19

Many candidates knew the products of anaerobic respiration in human muscles, but many incorrectly thought that carbon dioxide is produced as well as lactic acid.

Question 20

The formation of urine was not well understood with only a small number of candidates being able to select option **D** as the correct answer.

Question 25

There was a common misconception that the ovary produces the most progesterone in late pregnancy rather than the placenta.

Question 29

The majority of candidates could not work out the percentage chance of the male child having red-green colour blindness. The most common incorrect answer was option **C** suggesting perhaps that candidates had not read the question fully and had not realised that the child was male. Alternatively they may have only considered the chance of a child being male and ignored the inheritance of colour blindness. Or some may not have recalled that it is a sex-linked trait.

Question 37

Few candidates identified the cause of the reduced dissolved oxygen in eutrophication as increased aerobic respiration by decomposers.

Question 38

Many candidates were unclear on the role of chemical fertilisers, incorrectly believing they would reduce competition between crops and weeds.

BIOLOGY

Paper 0610/22
Multiple Choice (Extended)

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

General comments

There was a good understanding of the scientific naming of species, organs and tissues, enzymes, synapses, examples of asexual reproduction, and the causes of secondary sexual characteristics.

Candidates should be able to use descriptions of terms in the syllabus such as stem cells.

Candidates need to ensure they read all of the information provided in the questions (for example **Questions 9, 12 and 39**) and interpret diagrams and graphs carefully (such as **Questions 8, 24 and 39**).

Comments on specific questions

Question 7

Few candidates knew that digestion occurs in the duodenum.

Question 9

There was a common misconception that maltose is absorbed in the small intestine. Maltose has to be broken down to glucose by the action of maltase before it can be absorbed in the small intestine.

Question 11

A few candidates incorrectly thought that water moves by osmosis from the surfaces of the mesophyll cells into the air spaces in the leaves.

Question 12

Few candidates were able to interpret this experiment correctly, with the most common incorrect answer being option **B**. This option suggest they have not realised the grease on the upper surface is acting as a waterproof barrier to prevent water loss. Alternatively they may not have realised they needed to subtract this value from the total water loss per day.

Question 14

The concentration of urea in different blood vessels was not well understood. Candidates needed to recall that urea is produced in the liver and excreted in the kidney and then be able to link that to the blood vessels associated with these organs.

Question 19

Most candidates understood that the pupil would constrict in these circumstances but the mechanism of doing this was not well known.

Question 29

The majority of candidates knew that the sex chromosomes in sperm are X and Y. The fact that a single sperm is haploid and so contains X or Y rather than X and Y was not well understood with similar numbers of candidates choosing option **B** and option **D**.

Question 36

Only some candidates recalled the description of decomposition.

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Paper 0610/23
Multiple Choice (Extended)

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

General comments

There was a good understanding of the characteristics of living things, the binomial naming system, diffusion, chemical digestion, the events at a synapse, and the carbon cycle.

Candidates need to ensure they read all of the information provided in the questions (for example **Questions 4, 20, 27 and 33**) and interpret diagrams and graphs carefully (such as **Questions 6, 16, 28 and 36**).

Comments on specific questions

Question 4

Many candidates could not calculate the lumen diameter. The most common error was to not realise that the wall thickness goes all the way around the lumen and therefore needed to be subtracted twice.

Question 6

The majority of candidates could interpret the graph correctly but some thought that only the lowest concentration of sugar solution caused the potato to gain length.

Question 10

Most candidates were able to correctly explain why the ink drop moved but a few thought it would move away from the leaf.

Question 18

The majority of candidates knew the role of the external intercostal muscles but there was some confusion about the action of the diaphragm.

Question 19

Most candidates could follow the pathway of urea from production in the liver to excretion in the kidney. Some were confused about the location of either production or excretion.

Question 20

The role of the suspensory ligaments in focusing on a near object was less well understood than the role of the ciliary muscles.

Question 26

Many candidates incorrectly thought that antibiotics treat all diseases caused by pathogens.

Question 27

There was a common misconception that self-pollination produces genetically identical offspring.

Question 30

A few candidates thought that alleles are a pair of chromosomes.

Question 32

Although a majority of candidates knew that red-green colour blindness is a sex-linked characteristic, a small number thought that it was an example of codominance.

Question 36

Many candidates were unclear about the processes in the nitrogen cycle.

BIOLOGY

Paper 0610/31
Theory (Core)

Key messages

Candidates need to read the questions carefully, as they often contain specific information that must be used in the answer. Candidates often see one or two 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'.

General comments

Candidates often score well on the objective question but are unsure how to express themselves clearly in the longer prose questions.

Care should be taken with handwriting. If writing is illegible, marks cannot be awarded. This includes the writing of numbers.

Comments on specific questions

Question 1

- (a) Most candidates understood classification. The term binomial was not known by many candidates, and some did not know that the binomial system is made up of the genus and species name. *Gene* was sometimes given instead of *genus*.
- (b) Many candidates could use the key correctly and gained all five marks. When mistakes were made, they were usually for species **C**, **B** and **F**.
- (c) Most candidates were able to identify the groups. Candidates should use straight lines when completing diagrams of this type. Arachnids was the most common correct answer. The most common incorrect answer was the myriapods.

Question 2

- (a) Many gained both marks on this question, although some candidates did not understand the word element as most of the incorrect answers were not elements e.g. sugar, glucose, starch, carbon dioxide.
- (b) Very few candidates gained all three marks on this question. Most knew that amino acids were part of proteins or enzymes, but few were able to identify a large molecule that contained glucose, opting for sugar or carbohydrate. Glycogen or glycerol were common incorrect answers for glycerol.
- (c) (i) Many candidates chose to list the different parts of a balanced diet but left the list incomplete. Others wrote about meat, fish and vegetables rather than protein, fat and carbohydrate etc.

- (ii) This was answered well by many, most mentioning scurvy, rickets and strong bones but others gave very vague answers such as health or energy. Candidates were better informed about vitamins than minerals.

Question 3

- (a) (i) Most candidates were able to identify the cytoplasm and a ribosome. There was some confusion about the structure that controls the activity of the cell, some thinking this was the cell membrane. In some cases, it was difficult to differentiate between the letters **H** (for membrane) and **M** (for nucleus).
- (ii) Most were able to identify the mitochondrion but there were a wide variety of incorrect answers, such as ribosome.
- (b) Many knew that cell walls or chloroplasts are found in plant cells but not animal cells. Cytoplasm was the most common incorrect response, then ribosome.
- (c) Few candidates were able to correctly recall the word equation for aerobic respiration. Most included oxygen but there were mistakes on both sides of the equation.

Question 4

- (a) (i) Many gave differences in function rather than structure. Common mistakes were thin or small which were not linked to the lumen or the wall.
- (ii) Candidates found this question demanding. Few described the role as supplying substances such as glucose and oxygen and removing waste such as carbon dioxide. Many candidates said that capillaries joined up veins and arteries or carried blood.
- (iii) Some were able to identify the correct blood vessel, but a range of other vessels were also named. Vein alone was not enough.
- (b) This question was generally well answered although some mentioned effects rather than risk factors e.g. heart attack and death.

Question 5

- (a) The role of the nervous system was not well known, with very few giving a correct response.
- (b) (i) Most identified the correct structures in the peripheral nervous system but some included **R** (muscle) or **W** (relay neurone).
- (ii) This question was generally well answered although some used words rather than letters which did not answer the question. Candidates who did not score all five marks usually got the first three correct and then the last two incorrect.
- (iii) Many could not recall the term synapse and 'synapsis' was a common incorrect answer.

Question 6

- (a) (i) Candidates found this question very demanding and gave a wide variety of incorrect answers including glucose.
- (ii) Most knew that the effects were negative, but this was often limited to knowing that some fish or plants would die. Few mentioned oxygen depletion. Many candidates focused on the fertiliser being a pollutant.
- (b) (i) The question asked for a description, and many candidates gained all three marks. However, some attempted to give explanations which did not answer the question. Some candidates incorrectly used the term species, and some compared the composition of species by river; so for **A** and **B** separately rather than **A** versus **B**.
- (ii) Most identified the freshwater shrimp. The commonest incorrect response was bloodworm.

- (c) (i) Most candidates were able to extract the correct information from the graph. Very few gained the first mark as most put 24 rather than 24 000 or said the population size was increasing.
- (ii) Many candidates only gained one mark for extracting the correct figures from the graph. Many did not know how to do a percentage increase calculation.

Question 7

- (a) (i) Few candidates could name two suitable reasons. A common answer was to give an example of who bacteria are used rather than why, for example to make antibiotics.
- (ii) This question was quite well answered although some answers were vague, e.g. healthier, growing faster or bigger but not directly relating it to yield. The incorrect use of immune was seen quite frequently. Other common incorrect answers were about selective breeding rather than genetic modification.
- (b) (i) Most understood the data and gained all three marks on this question.
- (ii) Most candidates understood the relationship between pH and enzyme activity and answered correctly.

Question 8

- (a) (i) Candidates found this question demanding and few gained all four marks. The mark gained the most was the second one for photosynthesis.
- (ii) Most answered correctly. Common incorrect answers were combustion or decomposer.
- (b) Candidates found this question demanding and few gained all four marks. Many were able to give global warming or climate change as a consequence of burning fossil fuels, but very few seemed to be familiar with the term enhanced greenhouse effect. A wide range of incorrect gases were given for the last point, including nitrogen, oxygen and hydrogen.

BIOLOGY

Paper 0610/32
Theory (Core)

Key messages

Candidates need to read the questions carefully, as they often contain specific information that must be used in the answer. Candidates often see one or two 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'.

General comments

Candidates often do well on the objective question but are unsure how to express themselves clearly in the longer prose questions.

Care should be taken with handwriting. If writing is illegible, marks cannot be awarded. This includes the writing of numbers.

Comments on specific questions

Question 1

- (a) (i) The majority of candidates were able to answer this question correctly. The most common incorrect answers were mammals, amphibians and vertebrates.
- (ii) This question was well answered although some answers stated vertebrae which, although related to this term, has a different biological meaning. There were also a wide range of incorrect answers, including arachnids, amphibians and backbone.
- (iii) Fins and gills appeared quite frequently but candidates need to read the question carefully. The question asks for a visible feature and those that did not gain the mark often gave answers that were not visible on the diagram, such as scales. Many answers just stated bones, which is not a defining feature of a fish.
- (iv) Most candidates gained one mark, few gained both. Most common correct answers were hair or fur, mammary glands and external ears. Other marks were missed because candidates offered teeth or ears but without further detail. Few gained the second mark often referring to warm blood, four legs, having a backbone or giving birth to live young. Some answers stated features of any living organism, candidates must realise that a question that asks about features of a mammal requires a feature that is specific to mammals and not every other organism.
- (v) The vast majority gained rib, ribs or rib cage. A few candidates stated bones even though all the structures shown are bones, so **P** has to be pointing to a specific type of bone.
- (b) (i) Few candidates correctly stated *colchicus*. Common incorrect answers were *Phasianus* and bird.

- (ii) A number of candidates did not gain the first marking point because they referred to groups of animals instead of groups of organisms. Many candidates correctly gave the second marking point.

Question 2

- (a) (i) **B** was the most common answer but did not give an adequate explanation to get the second mark. Some candidates did not appear to understand the relevance of plasma in the stem of the question, often stating that the cell was similar in shape to plasma. Some answers referred to the salt solution being similar to the plasma and not referencing the red blood cell.
- (ii) There were a large number of incorrect answers, many candidates did not seem to understand that **B** should be in the middle, so not many correct answers of **C, B, A** were seen.
- (b) This question was well answered with most candidates stating nutrients, ions, oxygen, carbon dioxide and hormones. Candidates who were not awarded a mark tended to state cells like white blood cells or referred to waste products without specifying a substance like urea.
- (c) Most candidates were awarded one mark for stating that the cell increased in size. Some answers clearly stated that water enters the cell, often referring to the movement being from a higher water potential to a lower water potential, but did not state what the cell would look like which did not answer the question. Few candidates achieved a second mark. Many answers referred to the cell bursting, forgetting that the cell wall prevents this.
- (d) Very few candidates achieved full marks. Most knew that osmosis always requires a partially permeable membrane, but diffusion does not. Many candidates did appreciate that both diffusion and osmosis occur in all living cells.
- (e) There were a good number of correct responses. Common errors were diffusion and osmosis.

Question 3

- (a) (i) Many candidates clearly stated the appropriate responses and gained both marks. Photosynthesis was the most common correct answer. Very few gave gas exchange or chlorophyll production as a response. Several answers incorrectly suggested reproduction.
- (ii) A well answered question with most candidates naming bacteria and virus. Germs was not an acceptable answer. Some named diseases which did not answer the question. Phagocyte and lymphocyte were common incorrect answers.
- (iii) Candidates were generally able to identify two ways that pathogens are transmitted between trees, wind- and insect-pollination was a common answer that gained both marks. The idea of plant parts touching was not always clearly stated. A few candidates described how pathogens were spread between people instead of trees.
- (b) Most candidates were able to gain at least one mark with many describing three causes of deforestation. Reference to using land for building houses or infrastructure, farming, global warming, flooding and wildfires were the most common answers. Some candidates concentrated on clearing land and gave three different examples, such as houses, factories and roads. Some candidates incorrectly identified consequences of deforestation such as soil erosion rather than causes.
- (c) Generally, this question was well answered although some answers referred to the area of rainforest rather than the area of rainforest removed. The difference in the rate of decrease and increase was rarely seen. Some candidates just stated high or great instead of highest and greatest. Few commented on the two years where removal was the same. Candidates often gave data quotes but did not realise that the units were in thousand km², often just stating the value they read from the y-axis.
- (d) (i) Many candidates gained the second marking point but most did not write that it was the number of different species. Many candidates correctly referred to a particular area, ecosystem or environment but often referred to 'lots of species' or 'different species' or 'variety of species'. Candidates should realise that biodiversity can actually be calculated and so it is the number of species that is specific to this term. Many answers referred to the loss of organisms, clearly associating biodiversity solely with losing species. Other answers referred to animals or organisms and not species.

- (ii) Most candidates achieved at least one mark. Habitat loss and soil erosion were the most common correct answers. Other common answers were global warming and flooding. Many described oxygen loss, rather than carbon dioxide increase in the atmosphere. Climate change and global warming were often mentioned but enhanced greenhouse effect was rarely seen. Extinction, death, decreased populations, disrupted food chains, lack of food, and flooding were all seen. A few candidates confused consequences and causes.

Question 4

- (a) (i) Many candidates were awarded three marks.
- (ii) Many candidates drew an X in the correct place. The most common error was to place the X in or on the uterus or the ovary. Some candidates drew the X in the oviduct rather than using a label line which made it difficult to see.
- (iii) Some candidates may not have read the question carefully enough as they named the organ then tried to give a function of the organ. Many candidates named the hormone rather than describing its function.
- (b) Mostly well done, often scoring all five marks, although there was evidence of guessing by some candidates.

Question 5

- (a) Few candidates were awarded both marks. Most candidates knew that it was something to do with a gene, but answers were too vague to be credited. Candidates need learn the definitions as stated in the syllabus.
- (b) Very few candidates were awarded all four marks. The few that correctly identified the genotypes could not correctly explain their answers. There were many references to dominant alleles overpowering recessive ones or stronger genes being present. The genotype of individual 2 was mostly stated as GG with the explanation that it was green. Candidates did not appreciate that Gg will also give individual 2 a green colour but the offspring of individual 2 will be different to a GG genotype's offspring. Explanations were often not related to the pedigree chart given and did not use ideas about the colour of the offspring.
- (c) Many candidates did not correctly identify the gametes and then couldn't make the Punnett square work. Those that did start with the correct gametes were usually able to gain all three marks, though some did not correctly state the ratio. Many candidates wrote two alleles for the gametes even though they then still wrote two alleles for the resultant offspring. Candidates should appreciate that each gamete only has one of the alleles present so that the offspring can have two alleles.

Question 6

- (a) (i) Some candidates were unable to correctly identify the leaf as the organ containing spongy mesophyll cells, often referring to specific cells instead. There was a wide range of responses indicating some confusion over the term organ.
- (ii) Many candidates gained all three marks. The most common correct answers were J - cell wall and L - cytoplasm. Candidates found it more difficult to identify the vacuole. Common errors were nucleus and mitochondria.
- (iii) The majority of candidates were able to give a correct function of the nucleus. Most were able to reference genetic material although some incorrectly referred to the nucleus controlling movement in and out of the cell or that it stored energy or nutrients. Confusion with mitochondria was also seen.
- (iv) Candidates found it difficult to correctly show where mitochondria are found. Many identified the nucleus or vacuole. Some candidates tried to draw and then label their own mitochondrion which was confusing as their structures were generally the same shape and size as the chloroplasts.
- (v) A common error was to describe mitochondria as producing rather than releasing energy. Descriptions such as being 'the powerhouse of the cell' were too vague to gain credit.

- (b) Answers to this question were generally not well known or expressed, though a few gave excellent answers. Many candidates gave adaptations of cells as opposed to the spongy mesophyll tissue, showing a lack of understanding of the term tissue. The most common correct answer was reference to large surface area. Many did not gain the mark for chlorophyll absorbing light as they did not link the two, only mentioning chlorophyll or that light was absorbed.

Question 7

- (a) Most candidates gained a maximum of three of the four marks as they mistakenly thought there were two correct answers for chemical digestion and two correct answers for physical digestion. The most common incorrect links were between physical digestion and involves enzymes and physical digestion breaks down food molecules.
- (b) Many candidates gave the correct answer. Incorrect answers included a wide range of body parts and all parts of the digestive system from mouth to rectum were mentioned.
- (c) (i) Nearly all candidates were able to correctly identify structure **S** as the gum. Fewer were able to correctly identify structures **Q** and **R**. Crown was the most common incorrect answer for structure **Q** and pulp was the most common incorrect answer for **R**.
- (ii) Most were able to identify at least one correct structure found in the pulp with many identifying both. Two named blood vessels were frequently seen here.
- (iii) The vast majority were able to correctly identify the type of tooth as either a molar or a premolar. Fewer were able to explain their answer, and some describe the absence of a feature which did not really answer the question and was not accepted, for example 'not pointy'.

BIOLOGY

Paper 0610/33
Theory (Core)

Key messages

Candidates need to read the questions carefully, as they often contain specific information that must be used in the answer. Candidates often see one or two 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'.

General comments

Many candidates quoted the correct definitions from the syllabus. Care should be taken with similar words that have different meanings, such as fertiliser and fertilisation.

It is important to use precise values and correct units for data quotes.

When questions are about energy, it is important to remember that energy cannot be produced or created.

Comments on specific questions

Question 1

- (a) While candidates recognised that enzymes are catalysts, many were unclear about their role in chemical reactions.
- (b) Many candidates gave correct answers for both substrate and product, although some did not know the substrate.
- (c) This question was answered well. The shape of the curve was familiar to many candidates, so they were able to identify the optimum pH, and also describe the increase and decrease. Few candidates gave a suitable data quote as they did not give the units from the y-axis.
- (d) (i) Many candidates correctly selected the pancreas as the organ that produces protease. The most common error was the salivary gland.
(ii) Many candidates correctly selected small intestine.
- (e) Many candidates correctly described the acid killing microbes, but fewer described the acid creating the optimum pH for enzymes.
- (f) Many candidates incorrectly suggested that physical digestion involves the breakdown of large molecules into smaller ones.

Question 2

- (a) (i) Most candidates correctly identified the two structures.

- (ii) A common error was to give the name of the structure rather than its function. **C** was well known, but **D** was often incorrectly identified. Candidates should not use everyday terms such as 'powerhouse of the cell' or 'brain of the cell' as these are vague terms that do not give the detail required for the marking points.
- (b) (i) Most candidates correctly named the alveoli.
- (ii) Almost all candidates correctly named carbon dioxide.
- (c) (i) Many candidates found it challenging to get the parts of the excretory system in the correct order. Ureter and urethra were commonly misplaced.
- (ii) The question asks for two other substances. Many candidates gave urea as an answer, even though they were asked for answers other than urea.

Question 3

- (a) This question on transpiration proved demanding. Few candidates could recall the tissue involved or how water moves through it.
- (b) (i) This question was answered well by most candidates who used a simple calculation. A few candidates incorrectly calculated the mean value for the rates of transpiration at 30°C and 20°C.
- (ii) Many candidates correctly identified three correct conclusions.

Question 4

- (a) While most candidates knew that fertilisation involved gametes, very few stated that the nuclei fuse.
- (b) (i) Few candidates were able to identify or give the role of the acrosome, but most were able to give the role of the flagellum.
- (ii) Many candidates correctly named the organ.
- (iii) This question was generally answered well, but a few candidates gave a single chromosome or the number of chromosomes.
- (iv) Nearly all candidates gave the correct answer.

Question 5

- (a) (i) It was important to read the question and the data carefully. Each bar represented 5 years, but some candidates counted 5 actual bars for 5 years. To obtain the answer they should have looked for the greatest difference between adjacent bars.
- (ii) Most candidates selected the correct figures from the bar chart and stated the percentage increase. A common error was to divide 200 by 350 instead of 150. Most candidates were able to round their answers to a whole number.
- (b) This question was generally answered well, with most candidates able to give at least two methods.
- (c) (i) There were some good answers, such as using less space, more product and easy to care for the livestock. Most candidates could one or two correct advantages, but fewer could give all three.
- (ii) The effects of untreated sewage were well known. The most common correct answers were pollution, habitat destruction and disease.

Question 6

- (a) (i) Most candidates correctly stated *Lactobacillus* as the genus name.
- (ii) This question asked for the properties of bacteria themselves, rather than the technology of making food products. Many candidates misread the question.

- (b) (i) The question was set out to help candidates calculate the amount of protein in 200 g of yoghurt and to follow this with the amount of additional protein needed. A few candidates misread the question and instead tried to calculate the mass of extra yoghurt needed.
- (ii) A few answers were about maintaining a balanced diet although most answers related to energy release or insulation. It is important to remember that energy cannot be produced.
- (iii) Most candidates knew one dietary source of fibre.
- (c) (i) Common errors were to give the equation for aerobic respiration or for anaerobic respiration in animals, others added yeast as a reactant in the equation.
- (ii) Most candidates could recall the correct role of yeast.
- (iii) Most candidates knew one other use of yeast in biotechnology.

Question 7

- (a) (i) Tropic responses of plants were not well understood although most candidates did attempt the drawing. Unfortunately many drew both the roots and the shoot growing downwards suggesting some uncertainty about the effects of gravitropism.
- (ii) Candidates appeared to only know phototropism. Very few gave the correct answer, although some did refer to gravity.
- (b) This was answered well, with many candidates correctly describing the absorption of water and minerals. A few also described the large surface area.

Question 8

- (a) (i) Many candidates identified the pupil correctly, but a number gave iris, lens or retina.
- (ii) Few correctly stated that the iris controls how much light enters the eye. Common answers were that it refracts light or protects the eye.
- (b) (i) Many candidates did not use the definition as given in the syllabus or refer to DNA. Most answers were about alleles and passing on of characteristics.
- (ii) This proved to be a challenging question with many candidates incorrectly referring to the environment affecting eyelash length. Very few correctly referred to the limited number of categories.
- (c) (i) A few candidates were able to correctly complete the table. Many answers showed **ee** being both heterozygous and homozygous, or **Ee** being both dominant and recessive.
- (ii) Some candidates were able to complete the Punnett square correctly. A common mistake was to give gamete two alleles. Despite this, many recognised that the offspring should have two alleles. Many were not able to give the correct ratio for the offspring in the Punnett square.

BIOLOGY

Paper 0610/41
Theory (Extended)

Key messages

Candidates should know that command words such as 'state', 'describe', 'explain', 'suggest' and 'outline' require different types of responses. Candidates should be encouraged to identify the differences in the requirements for each command word and in particular the difference between questions that ask for comparisons and explanations, for example **Question 5(a)(ii)**.

When asked to use label lines to label a structure on a diagram for example in **Question 4(c)**, candidates should ensure that their label lines touch the relevant structure. They should avoid using arrowheads at the ends of the lines as these can be ambiguous.

Candidates should be aware that questions without answer lines can be easily missed, for example **Question 5(a)(iii)**.

Candidates should use the mark allocation and the number of answer lines as a guide to how many different pieces of information to include in each answer. If a question is allocated three marks, then usually three separate points must be made for full marks to be awarded.

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

General comments

Many candidates were unfamiliar with the nitrogen cycle in **Question 3**. Answers to the 6-mark question, **Question 3(c)**, were often vague or not attempted at all. Knowledge of sexual reproduction in a flower, **Question 4(d)**, was lacking by many candidates. Finally, the ability to explain how sweating helps maintain a constant body temperature in **Question 5(b)(i)** was challenging for many candidates.

Some candidates showed a good understanding of key biological knowledge and used biological terminology appropriately. There were a few excellent performances on this paper, but many candidates found some of the questions requiring synthesis challenging. This was the case for some of the questions that required comparisons and explanations rather than simple descriptions, especially **Question 5(a)(ii)**, which necessitated a careful and logical approach in order to analyse information in the graph.

Some candidates did not read the questions carefully enough. For example, in **Question 2(b)(i)** many candidates did not describe differences in structure and simply described differences in the types of circulatory systems in fish and humans.

The questions that required candidates to use information in diagrams, such as Figure 2.1 and Figure 2.2 or using the letters in Figure 3.1 were more challenging. Figure 6.1 was a diagram to aid candidates with their explanation as to how mRNA is involved in protein synthesis, a few candidates were unable to use the diagram to their benefit. Many candidates were less proficient at answering questions that required application of knowledge and understanding compared with those that required simple recall of knowledge.

Comments on specific questions

Question 1

- (a) Most candidates gained full marks, with nearly all others getting two of the three marks available. The most common error was to confuse **A** and **C**, suggesting that these candidates were unsure of the meaning of 'spiral'.
- (b) (i) Many candidates achieved three out of the four marks, as they omitted the cubed symbol for the volume. Many candidates were able to gain a mark for giving the radius.
- (ii) Only a few candidates could recall the correct kingdom.
- (c) (i) Very few candidates gained both marks, although quite a few identified **K** correctly. The most common incorrect answer was protein wall for **J**.
- (ii) The majority of candidates were able to suggest two structures found in bacteria but not in viruses. A minority suggested incorrect structures such as a nucleus or mitochondria.

Question 2

- (a) (i) Very few candidates gained full marks for this question. The pulmonary artery and aorta were most likely to be correct, with the renal vein next. Candidates struggled to identify the hepatic portal vein.
- (ii) Most candidates were able to gain both marks.
- (b) (i) Very few candidates gained full marks. Candidates were asked to describe differences in structure between a fish heart and a human heart, so they should have compared the diagram to their knowledge of the structure of a human heart, rather than describing the different types of circulation. The most commonly awarded marks were for the different number of chambers, and the lack of a septum.
- (ii) Many candidates gained one mark but had difficulty in explaining other advantages of a double circulatory system. The next most commonly awarded marks were for the faster flow of blood and higher blood pressure. It was rare to see responses that included reference to allowing a high metabolic rate, filtration in the kidneys and more time for gas exchange.
- (c) (i) Most candidates were able to identify the red blood cell. A few candidates incorrectly identified structure **P** as the lumen of the arteriole.
- (ii) Many candidates gave the correct formula. Candidates who attempted to put in values for each part of the equation had misunderstood the instruction to write the formula. The formula triangle was insufficient.
- (iii) Few candidates were able to convert from mm to μm .

Question 3

- (a) (i) Many candidates were unable to interpret the diagram and only a minority were awarded both marks. Many candidates incorrectly referred to deamination.
- (ii) Candidates should take care to write lightning correctly (instead of lighting). Some suggested thunder or rain instead of lightning. Many candidates had knowledge of the requirement of bacteria for nitrogen fixation, but some incorrectly referred to nitrifying or denitrifying bacteria so the mark for bacteria was not awarded.
- (iii) Many candidates were unable to identify compound **Y** as ammonia or ammonium ions.
- (iv) Most candidates were able to identify the liver as the site of assimilation and deamination. Some suggest part of the small intestine, perhaps because they only read the word assimilation in the question stem.

- (v) Far more candidates gained the second mark, for the formation of urea as the end of deamination, than the first mark. Many candidates recognised that the amino acids were separated into two parts but were unable to express the removal of the nitrogen containing part of amino acids clearly.
- (b) Most candidates gained the last three marks. Very few gave the greenhouse effect as the first answer, many candidates referred to global warming or greenhouse gases which were not accepted. It was extremely rare to see responses which included rice in the second space.
- (c) A few candidates gave a very good explanation of the process of eutrophication and should be congratulated, easily gaining full marks. These candidates gave a detailed explanation of how eutrophication was caused, referring to the causes of the death of plants, the aerobic respiration of decomposers and the death of organisms due to lack of oxygen. Some mistook algae for decomposers and stated that algae were responsible for the reduction in the oxygen concentration in the water. A very small number of candidates suggested that the death of marine organisms was caused by toxicity of the fertilisers entering the lake which did not answer the question. Some candidates were confused with the cause, with some suggesting that pesticides or herbicides cause eutrophication.

Question 4

- (a) (i) Most candidates gained one or two marks, generally from a combination of scent, nectar or colourful petals.
 - (ii) Nearly all candidates were able to suggest that the pollen grains were sticky or had spikes.
- (b) The most common correct answers were that monocotyledonous plants had parallel (leaf) veins, one cotyledon or petals in multiples of three. Candidates often gave only one correct answer.
- (c) Most candidates could identify the ovule, and many labelled a filament correctly.
- (d) A few candidates gave a very good explanation of the process of sexual reproduction, easily gaining full marks. Many candidates often did not outline the stages in any detail or use correct terms. Many mentioned fertilisation occurring which was enough to gain one mark, but the events leading up to fertilisation were often vague and so did not gain any further credit. A common error to omit details of the pollen tube growing from the pollen grain. There was also confusion over whether it was pollen or the pollen tube that reached the ovule. A few mentioned the male nucleus moving down the pollen tube or that fusion occurs between the male and female nuclei, rather than male and female gametes.
- (e) (i) This was answered very well with most candidates giving the correct answer.
 - (ii) Most candidates answered correctly.
 - (iii) Some candidates gave the correct response of meiosis, although some suggested mitosis.
 - (iv) Few candidates could recall the function of the prostate gland.

Question 5

- (a) (i) The majority of candidates gave the correct answer.
 - (ii) Very few candidates gained full marks. Marks were often missed due to poor use of terminology. Answers about transpiration and humidity should use the term 'water vapour' rather than just water, and ideally, they should refer to the water potential inside the leaf and in the atmosphere. Many candidates had the right idea but wrote about concentration. Some candidates got confused and stated that in high humidity the leaf absorbed water from the atmosphere.
 - (iii) Some candidates did not attempt this question. Most who did correctly drew a line above the original two lines. A minority of candidates redrew the whole graph which was unnecessary.
- (b) (i) This question proved to be demanding. Many candidates mentioned sweating, but not that sweat was produced by sweat glands. Fewer wrote that sweat evaporates, or that the heat energy used to evaporate the sweat comes from the body. The most common mark awarded was for a reference to homeostasis or negative feedback.

- (ii) Many candidates ignored the word 'vapour' in the question, so they stated that water was lost as urine or tears.

Question 6

- (a) (i) Most candidates were awarded the mark for nucleus.
- (b) Most candidates were able to name a protein or a type of protein. There was a minority who suggested a nucleotide base such as adenine or thymine.
- (c) Some candidates gained full marks by describing transcription, the movement of the mRNA out of the nucleus, and the reading of the mRNA by the ribosome, or translation. Some candidates described mRNA as a copy of the gene and most stated that mRNA moves from the nucleus to the ribosome. Many could describe proteins being made of amino acids at the ribosomes, but fewer stated that mRNA passes through the ribosome or described what determines the sequence of the amino acids in a protein. A few candidates did not explain how proteins are made, instead they wrote about the ribosomes breaking down proteins into amino acids. Many responses to this question were often vague and omitted the essential details of the process.

BIOLOGY

Paper 0610/42
Theory (Extended)

Key messages

Candidates should read all stimulus material carefully and take note of the command words used. This was important for questions: **Question 2(c)** where many candidates drew a cross-section of a stem instead of a root; **Question 2(e)** when only descriptions and were given instead of a description and an explanation; and **Question 4(b)(i)** where the responses had to be given in the context of after the reintroduction of horses to the wild.

It would be beneficial for candidates to practice the spelling of keywords, particularly in cases where they could be confused with another biological term. The spelling of mitosis was important in **Question 4(c)**.

Learning descriptions of key terms in the syllabus is important for answering questions directly as well as providing scaffolding for longer prose questions. Knowing the meaning of the term physical digestion was important for **Question 1(a)** and the meaning of the term catalyst for **Question 4(a)**.

General comments

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

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

Comments on specific questions

Question 1

- (a) A very common misconception was that physical breakdown involves the breakdown of larger molecules to smaller molecules. Some candidates omitted to state that the substances do not undergo any chemical changes.
- (b) The correct letters were commonly identified. The liver was sometimes incorrectly identified as the site of production of glucagon. The pancreas or the gall bladder were sometimes incorrectly identified as the site of production of bile.
- (c) There were some accurate explanations of the role of bile in the neutralisation of stomach acid. However, this question asked for the role of bile in physical digestion, hence responses such as these were irrelevant and were not awarded marks. Those candidates that recognised the question was about physical digestion often gave explanations using the correct scientific language. Occasionally there was some confusion between physical digestion and chemical digestion with some candidates incorrectly referring to bile as an enzyme or containing enzymes.
- (d) This question was generally answered well, with most candidates able to identify types of human teeth and their function. Occasionally candidates gave contradictory roles, for example, describing molars as cutting and grinding food, or incisors tearing and grinding food.

- (e) Candidates that identified **X** as microvilli and **Y** as the lacteal generally were also able to explain their roles. **X** was sometimes misidentified as cilia, mitochondria or the epithelial layer. The role of the microvilli was sometimes insufficiently explained, with some candidates omitting to mention that the increased surface area that they provide is required for more effective absorption. A significant number of candidates identified **X** and **Y** as parts of plants such as xylem and phloem.

Question 2

- (a) (i) Parts of generalised cells were often given, such as cell membrane and cell walls, which are not considered main features of plants as these are also found in fungi. References to cellulose cell walls, which are a main feature of plants was accepted. A significant number of candidates contradicted themselves by referring to plants as being multicellular and unicellular. The most common correct responses were references to the presence of chloroplasts and the ability to photosynthesise.
- (ii) This question was generally answered well, with many correct kingdoms seen. A number of candidates identified bacteria as a kingdom instead of prokaryotes. Occasionally, candidates gave the names of smaller classification groups such as mammals.
- (b) This was a demanding question. However, some candidates were able to correctly describe the distribution of vascular bundles as being in a ring in a dicotyledonous plant.
- (c) Many candidates found it difficult to accurately draw the distribution of xylem and phloem in a dicotyledonous root. The root hair was frequently identified. The distribution of xylem and phloem were sometimes incorrectly shown as how the distribution would appear in a stem instead of a root and some candidates simply redrew the distribution found in a monocotyledonous stem. A number of candidates added additional root hairs to the diagram, which was not required. Candidates should be reminded to draw diagrams with care. A sharp pencil should be used and label lines, drawn with a ruler, should touch the actual structure they are labelling.
- (d) Many candidates could accurately describe the functions of xylem. Very occasionally candidates described xylem as absorbing water and mineral ions rather than transporting water and mineral ions.
- (e) This question required the application of the candidate's knowledge of translocation and the role of the phloem. Candidates were generally able to describe the results, but the explanation proved more challenging. The best responses recognised the source as being the leaves and realised that with the phloem being cut, the sucrose and amino acids would stay in the upper part of the tree and enhance the growth of the fruit. Some candidates tried to explain this in terms of the transport of water to the fruits. There were some vague responses referring to the movement of nutrients or food. The correct scientific language should always be used. Candidates should know that it is glucose that is made during photosynthesis and then transported as sucrose in the phloem. Some candidates described the girdled tree being heavier rather than the fruits gaining in mass, and while some did perform some data analysis, they forgot to include the relevant units.
- (f) The correct enzyme pectinase was often seen. Common incorrect enzymes included lipase and pepsin.

Question 3

- (a) Most candidates were able to describe the meaning of the term catalyst. Occasionally there was some confusion between the term enzyme and catalyst. Sometimes there were inaccuracies, such as stating that catalysts are not involved in the reaction. Responses such as this did not gain credit.
- (b) (i) It was evident there were several misconceptions held by candidates, for instance, that amylase is denatured at 0°C. Some candidates gave excellent explanations of the effect of temperatures above 40°C on enzyme activity. However, these were irrelevant as the question asked for an explanation between 0°C and 40°C only. There were several responses that did not explain the lack of enzyme activity at 0°C and only explained an increase in enzyme activity. The best responses explained the effect of the temperatures given on enzyme activity using subject-specific language and referring to kinetic energy and enzyme-substrate complexes. Few candidates were able to explain the relevance of the colour changes shown by the iodine solution and relate this to the activity of amylase. In addition, many candidates simply described the results and did not attempt an explanation. This

question allowed candidates to gain marks relating to enzyme activity at different temperatures. Stronger responses linked the idea of amylase catalysing the breakdown of starch with enzyme activity at these temperatures.

- (ii) Most candidates were able to explain the presence of a blue-black colour in terms of the specificity of enzymes. Fewer went into further depth to explain this in terms of complementary shapes of the substrate and the enzymes active site.
- (c) The most common correct factor affecting enzyme action was pH. Other correct factors were also credited.

Question 4

- (a) (i) This question was generally answered well, with grasshopper being the most common correct response. A number of candidates gave the names of producers: grass or sage plant, rather than one of the primary consumers. It is likely that candidates confused primary consumer with producer.
- (ii) The question asked for a food chain to be constructed. A significant number of candidates opted to draw a pyramid. Occasionally food chains were drawn with the incorrect organisms or the wrong number of organisms. Some candidates did not use appropriate arrows to show the direction of energy flow through the food chain so did not gain credit. There were examples of food webs, where candidates had tried to recreate a food web with four trophic levels rather than a food chain.
- (iii) Candidates that answered this in terms of energy loss, generally answered well. Several correct examples of energy loss were seen.
- (b) (i) The best responses answered this question with reference to a lack of genetic diversity and the consequences that arise from this. There were some reasonable suggestions in terms of imbalance of males to females that could prevent breeding. Occasionally, candidates stated that horses would not be able to adapt to their environment rather than a changing environment. Many candidates mentioned the spread of disease, with the best responses distinguishing between communicable and genetic diseases. These responses also demonstrated a sound understanding of the concept of homozygosity.
- (ii) There were many detailed responses, giving a variety of methods that could be used for conservation including protection of habitat and species and references to education and monitoring. There was confusion with some candidates giving methods such as artificial insemination and selective breeding, which can be used to increase the number of organisms, but the question specifies the maintenance after the horse's reintroduction.
- (c) Fertilisation was frequently seen as process X although some candidates stated fusion, which was not credited. The processes of mitosis and meiosis were sometimes confused. The process occurring at Z proved the most challenging. 'Implementation' was a common error for Z, and many tried to describe the process rather than name it.

Question 5

- (a) Some candidates did not go into the depth required and simply discussed an increase in the number of livestock. The best responses discussed the benefit to the environment, consumers and the farmer. Many candidates did not give sufficient specific details to allow credit to be given but responded in rather general terms. Candidates should be aware that when describing benefits or drawbacks, it is helpful for them to be clear who or what stands to gain or suffer, as ambiguity led to missed credit. For example, a response which specifies that something is cheaper was not creditworthy for this question unless qualified by cheaper products or the fact that it would be cheaper for the consumer, since intensive systems are frequently more costly to establish and run, so not cheaper for the producer. A number also confused the concept of intensive livestock with wild populations and gave answers which would have been more relevant to the previous question on restoration of an endangered species.
- (b) Many candidates recognised that the cramped living conditions associated with intensive livestock production facilitates the spread of disease. Some described vaguer ideas such as 'unhygienic conditions' which could not be given marks. Fewer candidates specified that antibiotics would be required to treat bacterial diseases. Many described the need to prevent pathogens but did not

specify which group these belonged to or incorrectly stated that viruses would be prevented. Many candidates wrote at length about the action of antibiotics on bacterial cells, but this was not relevant to the context of intensive production.

- (c) (i) Many candidates identified the correct countries of **D** and **F**. Occasionally, candidates only gave one country. A few instances were seen in which all the countries except for **D** and **F** were listed, suggesting that candidates had not read the question carefully enough or had misinterpreted the instructions.
- (ii) Many candidates completed the calculation well and clearly laid out their working. Readings from the graph were accurate. There were occasional errors in the calculation of the percentage increase and when rounding. Where working was shown, many candidates were able to gain one or two of the three available marks even when errors in data selection, calculation or rounding occurred.
- (iii) A common misconception among candidates is that the use of antibiotics causes mutation in the bacteria. This is incorrect yet was seen frequently in responses. Mutation is random and the selection pressure of antibiotics allows these bacteria with the mutant resistant alleles to survive and reproduce. Occasionally, candidates tried to explain this in terms of selective breeding or genetic modification. Many candidates gave comprehensive and correct accounts of the selection pressures exerted by antibiotics and could use the term natural selection correctly as part of this. Some candidates could describe an increase in the population of resistant bacteria but did not go on to state that the proportion of resistant bacteria in the overall bacterial population would increase. Where candidates started their description with a random mutation, full marks could often be gained, but candidates who began with a description of misuse of antibiotics frequently made errors, attributing mutation to antibiotic misuse or writing incorrectly about antibiotic resistance gradually building up rather than being conferred by a gene.

Question 6

- (a) Care should be taken when taking readings from graphs. Few candidates were able to calculate the decrease in heart rate between 20 and 40 minutes. Many candidates were able to correctly describe the consequences of anaerobic respiration and the actions taken by the body to remove the oxygen debt. Some candidates incorrectly stated that lactic acid was removed in the liver by anaerobic respiration, while some stated this process occurred in the heart or muscle.
- (b) (i) Liver was frequently seen. Incorrect organs included kidney, bladder and ureter.
- (ii) Kidney was frequently seen. Common incorrect responses included urethra, ureter and bladder.
- (c) Occasionally, the chemical equation for anaerobic respiration in humans was given. Some candidates gave incorrect reactants or products. Very occasionally candidates gave a word equation instead of a chemical equation.
- (d) Bread was a commonly seen correct product.

BIOLOGY

Paper 0610/43
Theory (Extended)

Key messages

Candidates should know that command words such as 'state', 'describe', 'explain', 'suggest' and 'outline' require different types of responses. For example, they need to respond to 'explain' questions with a different approach to those asking for a description.

Although the use of bullet points can help some candidates to focus their thoughts, individual terms without a relevant context are unlikely to answer a long-response question in sufficient detail.

Where candidates have continued an answer on a blank page or additional paper, they should clearly indicate which question is being answered.

General comments

There was generally good subject knowledge of eutrophication (**Question 2 (b)**), the structure of the heart and the effect of exercise on heart rate (**Question 4**) and tropic responses (**Question 5 (b)**). In contrast, the formation of urea (**Question 2 (c)**), the factors that affect transpiration (**Question 3 (b)(ii)** and **(iii)**) and the male reproductive system (**Question 6 (a)**) were less well understood.

There were questions where the principles were well understood but answers often did not use the appropriate terminology accurately, for example, questions on selective breeding (**Question 2 (a)(iii)**) and adaptive features of sperm (**Question 6 (c)**).

Some candidates did not read the question carefully enough and gave answers that did not match the question. Examples include explaining changes in breathing rate rather than heart rate (**Question 4 (b)(i)**), comparing the left and right sides of the heart, rather than the left atrium and left ventricle (**Question 4 (a)(ii)**) or naming the structure associated with the voice, rather than the hormone that causes the voice to deepen (**Question 6 (b)**).

Comments on specific questions

Question 1

- (a) Most candidates knew that the two parts of the scientific name in the binomial system are genus and species. Whereas phonetic spelling is accepted words that are similar to the terms but have another meaning are not, for example genes and genius.
- (b) Although many correctly concluded that the new species would be a fungus, many incorrect answers were seen, such as prokaryotes, bacteria and protoctists.
- (c) (i) Almost all candidates knew at least one structure that would be found in plant cells but not in animal cells. Common incorrect answers included cytoplasm and nucleus.
(ii) Although most candidates recognised the two species in the photographs as plants, fewer correctly identified them as a fern and a monocotyledon. Most candidates described some of the visible features but sometimes these contradicted the group to which they had classified the plant. Others described features of the seeds or flowers rather than the leaves that they could see in the photographs. Of the candidates who mentioned the spores of the fern, many described them as

being on the leaves, rather than the fronds. The most common correct visible feature identified was the parallel veins on the monocotyledonous plant.

- (iii) A wide range of suggestions of how to identify whether a species is closely related to an ancestor were seen. Some candidates described DNA testing but were not specific in mentioning the sequence of bases. Some stated that they had genes or alleles in common but did not state that this meant they were closely related or had recent ancestors.

Question 2

- (a) (i) The percentage change was correctly calculated by most candidates. A few candidates rounded their answers incorrectly giving an answer of 427% rather than 428%. Other candidates selected incorrect values or used the wrong formula, with the wrong denominator being the most common error. However, some credit could be given to those candidates who showed correct working.
- (ii) Many candidates used the data in the table to make sensible suggestions about why farmers had selectively bred the chickens. A few candidates mentioned that more eggs or meat could be produced but did not link this to the idea that the chickens reached reproductive age earlier.
- (iii) There were some confident answers describing the process of selective breeding in chickens with some candidates giving additional detail about how the farmers could breed the chickens. A common omission was to describe selecting the offspring with a large body mass but not going on to mention that they would breed these chickens together or that the process was repeated over many generations.
- (b) The majority of candidates realised that the chicken faeces could wash into the lake and cause eutrophication. The strongest answers referred to the increase of decomposers after the death of the producers and their use of aerobic respiration, but these points were only seen infrequently. Common errors included stating that the increased plants reduce the amount of oxygen or referring to an increase in carbon dioxide concentration in the water as the reason for the death of other aquatic animals.
- (c) This question was answered well. Many candidates knew that urea is formed by deamination in the liver and were able to correctly describe the process. The most common incorrect answers described excretion by the kidneys which did not answer the question.

Question 3

- (a) Almost all candidates knew that water in the soil would first travel through a root hair cell. Many of these candidates also knew that it would travel through the root cortex before reaching the xylem. However, many candidates approached the question incorrectly by describing the processes involved rather than the pathway and a common error was to describe the water movement as active transport.
- (b) (i) Most candidates correctly calculated the rate of transpiration at 30°C.
- (ii) Many candidates described the trend in the data correctly. However, some candidates only quoted the values from the table rather than manipulating the data to demonstrate the trend. Many candidates linked this trend to an increase in the kinetic energy of water molecules at higher temperatures but only the strongest responses correctly described the other steps in the process. A common incorrect statement was to describe more evaporation of water from the leaves rather than into the airspace within the mesophyll tissue or from the surface of the mesophyll cells. Few stated that there was increased diffusion through the stomata.
- (iii) A significant number of candidates incorrectly thought that low humidity occurs when there is more water vapour in the air. Of the candidates who did make a correct prediction, only a few could explain their prediction in sufficient detail. Many realised that there would be a lower concentration of water vapour molecules in the air but did not consider the change in gradient between the inside of the leaf and the air.
- (iv) Many candidates knew at least some of the terms in the sentences about water movement through a plant. The most common correct term was mineral ions in the first line although many mentioned

minerals, without qualifying them as mineral ions. Many candidates also incorrectly stated that molecules were held together by adhesion forces rather than cohesion.

- (c) (i) Some very comprehensive answers to explain how wilting occurs were seen with many candidates stating that a lack of water is the most common reason for wilting. A few candidates went on to explain that wilting occurs when more water is lost from a plant than is being absorbed. A common error was to state that the plant lost turgor rather than the cells. A number of candidates attempted to explain the loss of structure but omitted to mention that this was caused by lack of turgor pressure or that it was pressure on the cell walls. A common misconception was that reduced photosynthesis was a cause of wilting.
- (ii) Even though this question asked candidates to explain a way that the marram grass leaf is adapted to reduce transpiration, many simply wrote a list of features. Those candidates who did identify one feature often did not explain further than reducing water loss. A fairly common answer was to state that there was one stoma at the top of the leaf or one large air cell space in the centre. These descriptions suggest the candidates did not correctly identify the tissues in the photomicrograph.

Question 4

- (a) (i) The majority of candidates could correctly identify at least one of the labels on the heart diagram to complete the sentence, with **J** being the most common correct answer. Some candidates incorrectly identified the atrioventricular valve as a semilunar valve, **N**.
- (ii) Many candidates incorrectly stated that the wall of the left ventricle, **H**, was thicker than the wall of the left atrium, **D**, because it needed to withstand a high pressure. These candidates perhaps had confused arteries and veins with the walls of the heart. The most common correct answer was to mention that the blood leaving the ventricle needed to travel a longer distance. A few candidates had not read the question carefully and assumed that they were asked to compare the left and right sides of the heart.
- (iii) Many candidates correctly sequenced the numbers to show how a red blood cell moves through the mammalian circulatory system. Numbers that were often placed in the incorrect position were 4, 5 and 6.
- (b) (i) Most candidates explained at least some parts of the graph showing the change in heart rate as a result of exercise. Although many candidates realised that respiration was involved, only very few stated that respiration would release energy. Some candidates incorrectly stated that energy was needed for respiration. It was also uncommon to see reference to muscles, and muscle contraction with most candidates focusing on the delayed decrease in heart rate and not what makes it increase at the start of exercising. The most frequently awarded marks were for identifying increased need for oxygen delivery and that there was anaerobic respiration with lactic acid being produced, leading to an oxygen debt that was removed by the liver. Most candidates took note of the command word, and it was rare to see answers that included descriptions only. However, a number of responses included references to breathing rate rather than heart rate.
- (ii) Most candidates knew at least one risk factor for coronary heart disease. Some did not read the question carefully enough and suggested a lack of physical exercise even though this was stated in the question. A number of candidates wrote vague statements about diet, such as an 'unhealthy diet' or 'a diet or containing too much fat' without explaining that the fat that is the risk factor for coronary heart disease is saturated fat or cholesterol.

Question 5

- (a) (i) Almost all candidates knew the correct chemical equation for photosynthesis. Most candidates also balanced the equation correctly. It was rare to see the equation for respiration or anaerobic respiration stated. The most common error was with the formula of glucose.
- (ii) Most candidates knew that magnesium ions are required to make chlorophyll.
- (iii) Few candidates knew that starch is the storage carbohydrate in plants. Common incorrect answers included glucose, glycogen and sucrose.

- (b)(i) Almost all candidates correctly identified the response as phototropism. A few candidates described this response or stated that auxin was involved, rather than identifying the response.
- (ii) Some very comprehensive answers to explain the chemical control that resulted in the plant shoot bending towards the light were seen. Most candidates knew that auxin was involved and that there would be more auxin on the shaded side of the shoot. Fewer candidates knew the mechanism by which auxin becomes unequally distributed (diffusion) or that it is produced at the shoot tip. Some candidates stated that the plant, rather than the cells, became elongated. Others referred to elongation on the shaded side but failed to compare this with less elongation on the side facing the light.
- (iii) Almost all candidates knew that phototropism is an advantage to plants because it maximises the chance of receiving light for photosynthesis.

Question 6

- (a) The scrotum, urethra and the sperm duct were the parts of the male reproductive system that candidates identified correctly most often. Some candidates incorrectly stated that the scrotum regulates the temperature of the testes, or that the sperm duct makes sperm. Other candidates incorrectly identified either the sperm duct or the urethra as the ureter. Few candidates knew that the prostate gland produces seminal fluid.
- (b) Almost all candidates knew that testosterone is the hormone that deepens the voice. Some candidates wrote words that were a mix between the names of two hormones such as 'testrogen'.
- (c) Most candidates could explain one adaptive feature of a sperm, and many could give three. Almost all candidates knew that a sperm has a flagellum that is used for swimming although many candidates used the term tail and were not credited. Many candidates also knew that a sperm has an acrosome, but some candidates described the acrosome as the enzyme rather than containing the enzymes, or that the enzymes dissolved the jelly coat rather than the enzymes digesting it. Other candidates thought that the enzymes from the acrosome digested the egg cell membrane rather than the jelly coat. A few responses referred to mitochondria releasing energy but did not qualify the need for the energy. Other incorrect answers described the head being pointed so that it could pierce through to the egg. Very few candidates mentioned the nucleus and even fewer included that detail that it is a haploid nucleus. Many candidates correctly identified the parts but did not state the functions.

BIOLOGY

Paper 0610/51
Practical Test

Key messages

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

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

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

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

General comments

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

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

Comments on specific questions

Question 1

- (a) (i) Many candidates were able to record suitable values for **C** and **W** at the start and the end of the experiment.
- (ii) Some candidates were able to draw a suitable table that accurately represented the data they collected. The most common error was not including correct units in the headings. Candidates are reminded not to include units in the body of the table. Some did not record both the distance moved by the dye and the change in temperature.
- (iii) Few candidates realised that to calculate the rate they needed to divide the total distance moved by the dye by the time the celery stalk was in the beaker of dye (3 minutes). The unit would then have been a unit of distance per unit of time, for example mm per minute.
- (iv) When writing a suitable conclusion, candidates should be reminded that they are not simply restating the results they obtained, but rather stating the trends observed using comparative language. For example, as the water temperature increases, the rate of diffusion in the celery is faster. Candidates can go back to the beginning of the paper where the aim of the investigation is stated, this should be referenced when formulating the conclusion.

- (v) Some candidates knew that repeating an experiment helps to identify anomalous results. Many candidates incorrectly thought that experimental repeats are carried out to improve accuracy or prevent anomalies, or to enable an average to be calculated.
- (b) Many candidates correctly identified two variables that were kept constant in the investigation. The most common error was being too vague. Simply stating 'time' was not enough to gain the mark, but rather they needed to go on to qualify that it was the time left in the dye or time for equilibration.
- (c) (i) In this experiment, the temperature in the water-bath changes. The most appropriate improvement is to use a thermostatically controlled water-bath.
(ii) Many candidates were able to correctly identify an improvement to measuring the distance the dye moved as cutting thinner sections from the celery stalk.
- (d) (i) Most candidates correctly measured line **AB**, although a few measured in cm rather than in mm and did not change the unit to match. A smaller number were able to correctly use the calculation and then express their answers to one significant figure.
(ii) This question required candidates to compare the leaf miner fly with the black aphid. Vague answers with no qualification, such as size or shape were not credited. Candidates needed to give clear comparisons of both insects. Simply stating that one had more legs than the other was not credited. Only comparative language or direct comparisons were accepted.
- (e) Overall, candidates drew the celery leaf very well. Most candidates were able to draw a clear and continuous outline with no shading. Only a small number of candidates drew a leaf that was too small. The most challenging part of the drawing for candidates were the marking points for details with fewer gaining both of these marks.
- (f) Few candidates were familiar with the indicator used to test for carbon dioxide gas.

Question 2

- (a) Many candidates found it difficult to name the reagent needed to test for proteins. It is essential that candidates learn all the food tests.
- (b) (i) Overall, many candidates completed the graph to a good standard. The most common error was in choosing an appropriate scale. Candidates should be reminded that the chosen scale must allow the data points to cover more than half of the grid in both directions. When plotting the points, small and precise points should be used, rather than large circles. Many did not gain the mark for a suitable line of best fit. It is usually better to join each point to the next point with a ruled line if there is doubt about how to draw a line of best fit, as this is always accepted on a line graph unless a line of best fit is explicitly asked for. It is also important to note that lines should not be extrapolated beyond the data points.
(ii) Many candidates were able to correctly identify the relationship between height and vital capacity.
(iii) In order to gain both marking points for this question, candidates needed to make clear annotations on their graph at the height of 175 cm and correctly read the value using their graph line. A large number of candidates did not use the line to read the values but rather calculated these mathematically.

Question 3

This experimental design question required candidates to apply their knowledge of enzyme experiments to measure the effect of pH on the activity of amylase. It is evident that some candidates struggled to fully understand the components needed to design an experiment. Some candidates correctly identified suitable controlled variables, the most common being the temperature and volume of amylase. When discussing the need to repeat the experiment, it is important that it is repeated at least three times in the same conditions. Many were able to identify a relevant and suitable safety precaution.

BIOLOGY

<p>Paper 0610/52 Practical Test</p>

Key messages

Candidates should be familiar with the practical procedures indicated in the syllabus. This means that candidates are expected to be able to describe how to carry out these procedures in a safe manner and answer any questions that pertain to standard practical techniques.

When asked about safety considerations, candidates should identify a risk but also identify a method of reducing that risk. All safety precautions should be relevant to the specific practical task being undertaken.

Mathematical calculations form an important part of the practical assessment. It is essential that candidates show all of the working and also check their answers before moving on.

Candidates should ensure that they read the questions carefully before starting to answer. This is particularly important for any questions where additional information is given to advise candidates, such as not referring to size in an answer.

General comments

Candidates performed strongly on the paper overall with some very good marks. It was evident that practical laboratory skills were sound, and manipulation of the apparatus produced some good results with expected trends.

Mathematical skills throughout the paper proved a strength, although work on histograms could do with attention, in particular the differences between bar charts and the plotting of class interval data on a histogram.

Investigation planning was done with confidence with all key points covered. Most candidates also appeared to have understood the key points when drawing specimens, but care should be taken to avoid shading and more time should be given to the observation of detail.

Comments on specific questions

Question 1

- (a) (i) The candidates were asked to carry out a task with the respiration in yeast causing movement of a solution in an inverted test-tube. The results obtained suggested that this was done particularly well and with a high degree of competence. The presentation of data was done well with most candidates gaining at least three marks. A common error seen for a significant number of candidates was writing units in the body of the table or not including any units at all in the headings. Measurements of length can be shown as mm or cm, but correct units must be indicated.
- (ii) Generally, the conclusion matched the aims of the investigation. The most common error was to describe the relationship in terms of concentration and height of the yeast suspension rather than stating a conclusion in terms of the rate of respiration of the yeast. A valid conclusion should be based on the introduction in the stem of the question; candidates may need to go back to the stem as a reminder.
- (iii) Candidates were asked to state the independent and dependent variables. Some candidates confused the two, while others gave answers that lacked sufficient detail, such as simply stating glucose instead of concentration of glucose. It is important that candidates understand that the

dependent variable is the variable being measured, in this case height. rather than what can be concluded (rate of respiration of the yeast cells).

- (iv) This question, which asked for a method of maintaining the water-bath temperature, was generally very well answered with some clear descriptions.
- (v) The experimental procedure involved measuring a liquid inside a round-bottomed test-tube that was placed inside a beaker of water. The relatively complex nature of this procedure produced some unusual challenges when the height of the yeast suspension in the large test-tube was being measured. Many candidates were very good at identifying these problems and used their experience of the practical procedure to state clearly the potential source of error.
- (b) Some candidates found this calculation challenging. The use of a formula to help work out the relative volumes did not commonly lead to the correct answer.
- (c) Most of the candidates knew the reagent to test for reducing sugars, but a significant number forgot to include the heating of the reaction mixture. A water-bath alone is not sufficient as it needs to be heated, ideally to a temperature above 80 °C. It is important that candidates learn, and use, the test reagents for biological molecules outlined in the syllabus.
- (d) (i) Most candidates were able to state a positive test result for the ethanol emulsion test. Simply stating that it formed an emulsion was not sufficient.
(ii) For this question, candidates were asked for a safety precaution when using ethanol. Many stated that it should be kept away from heat rather than from open flames. Candidates should be encouraged to look for specific and relevant safety concerns rather than more general precautions such as wearing safety gloves and goggles.

Question 2

The plan was well done with a good range of marks awarded. A good proportion of candidates gained full marks and planned a concise but detailed investigation.

Most candidates were able to describe the independent variable with a range of exercise intensities being described. Fewer candidates were able to state what was actually being measured, with some stating that it was heart rate but not describing when it was measured. Other candidates described the effect of exercise on breathing rate. The method itself was generally described well, but there was some confusion when using a single person to do all of the intensities. This was true especially when describing replicates. The controlled variables were particularly well described. Most safety measures related directly to the investigation itself.

Question 3

- (a) (i) The drawing of the starfish was done very well by nearly all candidates. The drawings were done with neat and thin lines with suitable proportion and size. Some candidates did not observe the photograph in sufficient detail and missed some important distinguishing points. It is important that candidates attempt to copy any visible patterns as closely as possible. It is also important however that shading and stippling is not used to denote texture or patterning on the surface. This was seen in several cases.
 - (ii) The calculation of the actual diameter, including measurement of length **PQ**, appears to have been relatively straightforward for most candidates. A significant number of candidates were confused when rounding to two significant figures.
 - (iii) Generally, this question was answered well, but candidates need to make sure that they make comparative statements when asked to look for differences in two specimens. Differences also need to include sufficient detail – simply stating that the two starfish are different shapes for example is not enough. Descriptions must refer to the species and clearly state how they differ. The main reason for not gaining credit in this question was because candidates referred to size differences or similarities. Candidates were told not to include any references to size in their answers.
- (b) (i) This question asked candidates to read a short summary of an investigation and then state what features allowed the results to be compared, in other words, the standardised or controlled variables.

A number of candidates found this particularly challenging, despite it being largely a comprehension exercise.

- (ii) Few candidates gained all four marks for the graph. The question asked for a histogram of depth categories and frequency data. Many candidates struggled with the plotting of a suitable *x*-axis, leaving gaps between categories and so producing a bar chart rather than a histogram. The actual plotting of the data and labelling of the axes was excellent otherwise. All bars should be drawn with a ruler and need not be shaded.
- (iii) Most candidates were able to identify the depth range with the greatest number of starfish.
- (iv) This calculation was done very well, with candidates selecting the data and manipulating it correctly. Not all candidates rounded to a whole number.

BIOLOGY

Paper 0610/53
Practical Test

Key messages

Candidates should be familiar with the practical procedures indicated by the syllabus. This means that candidates are expected to be able to describe how to carry out these procedures in a safe manner and answer any questions that pertain to standard practical techniques.

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. Care should be taken when deciding if a value is given to the correct number of significant figures or decimal places.

It is essential that candidates take time to ensure that their written work is legible. All questions should be attempted and sufficient time allowed for the completion of all of the tasks.

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

General comments

Candidates demonstrated strong overall performance on the paper, consistently providing clear and concise answers. They demonstrated a very good level of ability when carrying out the invertase practical task and generated some very good results. These were presented well in an appropriate table.

The excellent planning for the heat loss investigation also highlighted a solid grasp of practical skills. This was emphasised by the thorough responses for the conclusion in Question 1 and the description of results and data presentation in Question 2.

Furthermore, the accurate plotting of graphs and calculations of size demonstrated a high level of understanding of the paper's requirements and the necessary skills.

When instructed to draw a biological specimen, candidates should dedicate sufficient time to fully observe all of its features. This keen observation is a critical component of practical biology.

Comments on specific questions

Question 1

- (a) Almost all of the candidates were able to measure and record the temperature of the water in the warm water-bath. Candidates should be reminded to record all temperature values in Celsius rather than Fahrenheit.
- (b) It was clear that the practical was carried out in an organised and timely manner, with results that matched the expected observations. The table to record the results from the investigation was done very well, with appropriate table structure and suitable headings. The inclusion of units in the body of the table was the most frequent error, with many choosing to put a percentage sign in the column of invertase concentration.

- (c) The conclusion for any investigation should be based on the original stated aims, as described at the start of the question. In this case a link was needed between the concentration of the enzyme used (invertase) and the breakdown of sucrose into reducing sugars. Many candidates simply described the results, rather than attempting to state the relationship between enzyme concentration and sucrose breakdown.
- (d) A large proportion of candidates found this question challenging. Some managed to identify the test-tube containing distilled water as a control for the investigation, but few were able to explain the purpose of having a control. A common mistake was to simply restate the contents of the test-tube rather than describing its use as a method of finding out if the sucrose was breaking down as a result of some other variable.
- (e) The identification of the independent variable was done well, but confusion with the dependent variable was seen in some cases. It was also noted that some candidates combined variables, stating for example that the independent variable was the concentration of invertase when it was mixed with sucrose solution at 40°C for 15 minutes. In order to gain a mark, just the independent variable needed to be stated.
- (f) For this question, candidates were asked why the test-tube containing the mixture of enzyme and substrate was placed in a warm water-bath. The reaction had already started, so the water-bath was not therefore used to equilibrate the solutions. This would only be true if the solutions had not yet been mixed and we needed them at the same temperature.
- (g) The idea of contamination was generally well understood with most candidates describing how the remains of one of the previous solutions could affect the solutions added to subsequent test-tubes. Some answers lacked detail and simply stated that it was to make the volumes more accurate. References to the removal of dirt or pathogens was not accepted.

Question 2

- (a) (i) Overall, candidates were able to identify two variables that were kept constant during the investigation. Marks were missed for several reasons. Firstly, temperature, although it may have been maintained for the duration of one experiment, was later changed as this was the independent variable. Secondly, answers tended to lack sufficient detail. Some candidates simply stated that time was kept constant, without describing which period of time they meant. Others stated that the yeast was kept constant, without identifying what aspect of the yeast they were referring to, such as concentration or volume.
- (ii) The identification of sources of error in this investigation was answered reasonably well. Sufficient detail should also be included – stating exactly what the source or error is rather than just saying ‘counting the bubbles’ for example. Some good descriptions of the use of a gas syringe were seen.
- (b) (i) Most candidates were able to calculate the rate of bubble production at the specified temperature, but there was some confusion with significant figures and decimal places.
- (ii) The graph was particularly well done with neatly plotted points and good presentation of data.

A few points to bear in mind for candidates who did not gain full marks:

- Axes must be linear and fully labelled with suitable values. This includes values on the *x*-axis or *y*-axis that include the final plotted point. In this case, the *y*-axis should not have stopped at 40, as one of the plotted points was at 41.
- The *x*-axis and *y*-axis do not have to start at zero. If they do not, the starting value must be shown.
- All plotted points should be of a small size, ideally drawn as a small neat cross or a small dot in a circle.
- The line joining the points must not be extrapolated in either direction.
- A line of best fit can be drawn, but in this case, it had to be a curved line of best fit which would go through all of the points. A straight line of best fit was unsuitable for this data.
- The question asked for the rate of bubble production to be plotted. Plotting the number of bubbles was not awarded marks.

- (iii) Some clear and concise descriptions of the results were seen from many candidates, with the trend stated and the optimum temperature identified. An explanation for the trend was not required.
- (c) It was clear that a good proportion of candidate had learnt the test for carbon dioxide using limewater.

Question 3

- (a) (i) The drawing of the head of the king penguin was very well done with some good clear drawings. The size was usually adequate, and all lines tended to be thin and unbroken. A few candidates did not observe some of the features carefully and missed out a few important lines around the beak and neck. Shading and stippling was also sometimes seen on the body of the bird.
- (ii) The calculation of the actual length of the penguin's beak was very well done with full marks obtained by many candidates. A significant number of candidates misread 46 mm on the ruler as 41 mm. The use of decimal places appeared to be understood by most.
- (b) Some very good comparative points were seen between the head of the gentoo penguin and the head of the black-footed penguin. Despite being told not to, some candidates compared the size of the head of the two birds.
- (c) This question asked candidates to plan an investigation to determine the effect of an insulator on heat loss in model penguins. The majority of candidates clearly understood the task fully and were able to describe some excellent methods. In most cases the dependent and independent variables were identified, and a number of relevant variables that should be kept constant were included. Methods were well laid-out with suitable descriptions of repeats. It must be remembered that safety precautions should be relevant to the task being described, and justification for their use should be possible.

BIOLOGY

Paper 0610/61
Alternative to Practical

Key messages

Candidates should be familiar with the practical procedures indicated in the syllabus. This means that candidates are expected to be able to describe how to carry out these procedures in a safe manner and answer any questions that pertain to standard practical techniques.

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. Care should be taken when deciding if a value is given to the correct number of significant figures or decimal places.

It is essential that candidates take time to ensure that their written work is legible. All questions should be attempted and sufficient time allowed for the completion of all of the tasks.

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

General comments

Good responses were concise and well expressed, and drawings were mostly well done. Candidates should be encouraged to fully explain the suggestions they make. Construction and labelling of tables and graphs could be improved, and workings for calculations should be shown as partial credit can often be awarded for workings.

When instructed to draw a biological specimen, candidates should dedicate sufficient time to fully observe all of its features. This keen observation is a critical component of practical biology.

Comments on specific questions

Question 1

- (a) (i) Most candidates correctly determined the changes in temperature, although some candidates added other temperatures or gave their answer as a percentage change.
- (ii) While most candidates could construct a suitable table, many gave 'celery stalk' as the first column heading. Candidates should be encouraged to provide a suitable heading for the independent variable (temperature in this case). Several candidates incorrectly included units in the body of the table (as opposed to stating the unit once in the heading). Some candidates only included the number of sections cut but did not fulfil the requirements of the question as they did not also include the data for the total distance moved by the dye.
- (iii) Some candidates understood the meaning of the term rate and knew that to determine the rate of movement of the dye they needed to calculate the total distance moved (65 mm) divided by the time the celery stalk was in the blue dye (10 minutes). Weaker responses just gave the total distance moved and did not appreciate the difference between distance and rate of movement. The correct

unit was used by several candidates. A common error was to abbreviate minute to 'm' which is the unit for metres and was not accepted.

- (iv) Many candidates correctly concluded that the water or dye moved faster in warm water. Some candidates only repeated the results rather than giving a conclusion.
- (v) Some candidates knew that repeating an experiment helps to identify anomalous results. Many candidates incorrectly thought that experimental repeats are carried out to improve accuracy or prevent anomalies, or to enable an average to be calculated.
- (b) Some candidates stated the independent or dependent variables instead of a variable that was kept constant. Others gave answers which were imprecise, such as 'blue dye' rather than 'both celery stalks were in blue dye', or 'size of celery' rather than specifying 'length of celery' or 'width of celery sections'. Another imprecise example was stating 'time' without specifying which time was constant. Many referred to the volume of the water or the dye being controlled but no information was given about them in the question.
- (c) (i) Although the question asked candidates to look at the data recorded for a source of error in the method, many focused on experimental techniques rather than noting that the temperatures varied. Several suggested incorrect answers such as variation in cutting 5 mm sections, experiencing difficulties seeing the position of the dye or not repeating the experiment. Those candidates who noted the temperature change often went on to correctly describe a suitable method to address this, such as using a thermostatically controlled water-bath or insulation.
(ii) Some candidates either did not attempt this question or incorrectly suggested using a microscope to determine precisely the final position of the blue dye in the xylem. Better responses described cutting thinner sections or cutting the celery longitudinally.
- (d) Many candidates gave the correct answer to two decimal places. The most common error was not halving the diameter value to give the radius value prior to using the given formula or not rounding the answer to two decimal places.
- (e) (i) Many candidates correctly measured line **AB**, although a few measured in cm rather than in mm and did not change the unit to match. Some candidates either confused one significant figure with one decimal place or did not attempt to round their answer.
(iii) Good answers made valid comparisons between the two insects by making either comparative statements, e.g. 'the leaf miner fly is larger', or describing both, e.g. 'the leaf miner fly has wings, but the black aphid does not'. Several candidates referred to just one insect with no comparative statement or no reference to the other insect, e.g. 'the leaf miner fly has wings', these did not gain credit as there was no reference to the black aphid. Others just stated a feature, e.g. 'wings', without stating a comparative difference.
- (f) Some good drawings were seen, with many candidates drawing a smooth single outline, without gaps, overlaps, double or sketched lines. There were relatively few cases of shading, stippling or the use of a ruler. Most drawings were of an appropriate size, without the drawing covering any of the text on the page. Detail marks were awarded to candidates who showed an appreciation of the different depths of cleft between leaf sections, and who had correctly reproduced the number and origin of veins emerging from the petiole.

Question 2

While many candidates could generally identify the independent and dependent variables, they did not always go on to give further detail of the dependent variable. The variables to be kept constant were generally well understood, although candidates should avoid using the terms 'amount' or 'quantity' in their descriptions and only use relevant terms such as 'volume' or 'concentration'. Candidates recognised the need for repetition of the whole experiment but not that two or more replicates were required. Safety precautions were generally relevant and suitable.

Stronger responses included details, such as sampling, and the use of spotting tiles or white surfaces and using buffers for the regulation of pH. Their descriptions suggested that these candidates were well-prepared for the assessment having experienced plenty of practical work.

Weaker responses showed some confusion about the starch test, suggesting blue-black as the desired end-point for full starch digestion or describing the end-point colour as yellow or orange, rather than brown. Others described different experiments, such as the decolourisation of leaves with ethanol and then testing for starch or varying the temperature rather than the pH. The question had specified the use of iodine solution in the experiment, but some used Benedict's solution instead. Some described experiments which would not have worked as they did not include the enzyme.

Question 3

- (a) (i) An important aspect of answering graphical questions is to make sure that the axes are suitably labelled, including the correct units. A suitable scale should also be chosen that ensures the area occupied by the plotted points covers more than half of the grid in both directions. The scale should also be linear and easy to apply. The line should be a point-to-point ruled line or a hand drawn single line and should not extend beyond the plotted points. It should be noted that a bar chart is not a line graph.

Many good graphs were seen. The commonest errors were the use of inappropriately small scales on the axes and not labelling the axes correctly. Some candidates demonstrated an awareness that they did not need to start the scales at 0 and they should include omission marks on the axes. This made the best use of the grid. A common error was the use of a non-linear scale which used the coordinates of the plotted points as the scale intervals.

- (ii) Most candidates were able to recognise that as the height increased so did the vital capacity.
- (iii) Many candidates drew neat and clear construction lines from their axis at 175 cm to their line and then to the appropriate value for vital capacity. These candidates were clearly well practised and prepared for using their graphical data in this way. Most correctly read the vital capacity from the graph, with accurate values given. Some candidates marked the value incorrectly or drew the intercept line at an angle. A small number did not indicate how they derived their estimated value or did not attempt the question.
- (b) The majority of candidates were confident that biuret reagent was the correct reagent. The most common incorrect answer was Benedict's solution. Common incorrect responses included protease, iodine or amylase.

BIOLOGY

Paper 0610/62
Alternative to Practical

Key messages

Candidates should know the differences between different types of graphs, such as bar charts, line graphs and histograms. Many candidates did not know that a histogram should have ranges on the x-axis rather than a linear scale and that the bars should touch, with no gaps between them.

In the investigation plan, candidates are not required to give expected results or explain any theory. In this paper, those that described how exercise increases heart rate and why heart rate increases rarely gained many marks. Candidates should identify relevant safety precautions in an investigation. It is not always relevant to use gloves and goggles, and other safety precautions should be considered.

A common error for the table construction question was to include units in the body of the table. Units should always be written in the column headings and not put into the body of the table.

When drawing graphs a sensible scale should be used. Many plotting errors were seen and often this was because the candidate used a difficult scale.

Candidates should be able to round their answers to a stated number of significant figures, decimal places or to a whole number. Candidates should be reminded to show their working in all calculations; this allows partial credit to be awarded even if an error is made.

General comments

Candidates demonstrated a good overall performance on the paper, consistently providing clear and concise answers. Many good investigation plans were written with candidates giving detailed methods that considered relevant constant variables and how the dependent variable would be measured.

When instructed to draw a biological specimen, candidates should dedicate sufficient time to fully observe all of its features. This keen observation is a critical component of practical biology.

Comments on specific questions

Question 1

- (a) (i) A table of results must have a sufficient number of columns and a line that separates the headings from the data cells. Some candidates did not include headers. Both % and cm or mm should have been in the headers and not in the body of the table. This was commonly seen when the heading of 'test-tube' was given rather than percentage glucose concentration and the percentage symbol was included in the body of the table. Accurate measurements are also essential. Some were out of tolerance. Additionally, candidates need to follow instructions carefully. They were asked to measure the height of the yeast suspension in the large test-tube and not the small test-tube.
- (ii) The conclusion for an investigation should always refer back to the aim of the investigation, rather than simply describing the results. In this case, the conclusion had to relate the concentration of glucose to the rate of respiration, rather than to the height of the yeast suspension.
- (iii) Candidates had to state the independent and dependent variables in this investigation; concentration of glucose solution and height of the yeast suspension respectively. The dependent variable was

often given as the rate of respiration. The rate of respiration was determined by measuring the height of the yeast suspension, so it is the height that is the dependent variable.

- (iv) Most candidates stated that the temperature could be controlled by using a thermostatically controlled water-bath. Others described the use of insulation, which was also a valid answer. Use of a thermometer only was not credited.
- (v) The majority of candidates described the idea that if the syringe was not clean there might be some residual glucose left in the syringe, which could cause contamination. Those that simply said an unclean syringe would make the results inaccurate or unreliable did not get the mark. Some said a clean syringe was used to avoid dirt or pathogens which was not accepted.
- (b) Candidates found this question challenging. A variety of answers were seen, and many candidates did not realise that their volumes for water and glucose solution should add up to 5 cm³. Sometimes the 3 cm³ and 2 cm³ were given the wrong way round.
- (c) Candidates should be very familiar with the food tests. Most candidates gave Benedict's reagent as an answer, but fewer also stated that the Benedict's should be heated with the sports drink. Some gave incorrect reagents, such as biuret. Candidates did not need to state the results of the test to get both marks.
- (d) (i) Answers that described a positive result of the ethanol emulsion test as cloudy, milky or white got a mark. Colourless was ignored. Occasionally, other colours were seen such as blue-black (for iodine) or red (for Benedict's).
- (ii) Ethanol is flammable. Therefore, a relevant safety precaution would be to keep the ethanol away from flames. Keeping ethanol away from heat was not enough for the mark. Many candidates seemed to think that ethanol is an irritant or corrosive and so suggested the use of gloves or a mask. Both of these answers were not credited. However, the use of goggles was given the mark as eye protection is relevant.

Question 2

This was an investigation that most candidates were familiar with, and some high scoring responses were seen. A common error was to only describe measuring the difference in heart rate before and after exercise, or at rest and after exercise. This method does not have exercise intensity as the independent variable. Some only described measuring heart rate but did not say when that would be done. It was important to say that heart rate would be measured either during or after exercise. Some candidates chose the wrong dependent variable and described measuring breathing rate. Candidates described the constant variables well, often giving age, sex and height of the participants. Running for different times, speeds or distances was a commonly described independent variable. As these candidates had gone further than simply saying exercise was carried out at different intensities, they got marking points 1 and 3. Many described good methods of measuring heart rate, such as the use of a stethoscope, heart rate monitor or ECG. It is not necessary to describe expected results in an investigation plan. Occasionally, candidates described and explained the effect of exercise intensity on heart rate rather than describing an investigation. For the safety mark candidates should remember that they are trying to prevent an incident, for example wearing appropriate footwear or not using participants with health issues, having a first aid kit is not sufficient.

Question 3

- (a) (i) Candidates had to draw a large diagram of a necklace starfish. Candidates should remember not to use shading in their diagram even if the photograph shows a specimen that is different colours. The outline should be clearly drawn with no overlapping lines, gaps or sketchy lines. For the size mark, candidates should make sure that their drawing does not touch the text around the drawing space. This was the most common error for the size mark. The details that were assessed were drawing a central region that did not touch the edges and indicating a colour change in each of the five arms. Some candidates did not include any internal detail so were not able to get either of the detail marks.
- (ii) Most measured the line **PQ** correctly as 93 mm and divided this length by 0.32. However, some multiplied their length by 0.32. Errors were seen when rounding to two significant figures. 290.625 rounded to two significant figures is 290. Some gave their answer to two decimal places. A large number rounded 290.625 to 29.

- (iii) Candidates had to describe two differences and one similarity between the spiny and necklace starfish. It is important to read all instructions because the question specified that answers should not refer to size. Candidates should also remember to give comparative statements when describing differences. For example, those that simply said that the spiny starfish had spikes did not get a mark if there was no reference to the necklace starfish. Candidates were not expected to know the terminology to describe the starfish arms, so a variety of descriptions were accepted as alternatives.
- (b) (i) There were a variety of variables that candidates could choose to give as their answers for this question. However, many candidates did not realise that they were being asked to give variables that were kept constant. Instead, they described how to improve the investigation or gave steps to calculate a mean number of starfish. Some of the variables described were not quite right. For example, the depth of the water was always measured when the water was at high tide, but some candidates said that the photographs were always taken when the water was at high tide. This was not true. Some said that the photographs were taken at the same time, but they should have said the same day as they were not told what time the photographs were taken. Candidates should remember to be specific when identifying the variables that are kept constant, 'same area' was insufficient, they needed to refer to the size of the area.
- (ii) Candidates were asked to plot a histogram of the data. Candidates should know the differences between a bar chart and a histogram. The histogram should have had the depth ranges on the x-axis, rather than a linear scale (like the y-axis) and the bars should have been touching, with all having the same width. Many plotting errors were seen. Candidates should use a sensible scale to make plotting easier. Some candidates started to give a linear scale for the y-axis, but then it became uneven above 1000.
- (iii) The majority of candidates gave the correct answer of 10.0–19.9 as the depth range that most seven-armed starfish were found.
- (iv) Most gave the total number of starfish as 3428 and most calculated the percentage at 0.0–9.9m as 9.8 and rounded to a whole number as 10. Some did not give their answer as a whole number and some rounded incorrectly to 9. There were some candidates that calculated a percentage change, rather than a straightforward percentage.

BIOLOGY

Paper 0610/63
Alternative to Practical

Key messages

Candidates should be familiar with the practical procedures indicated by the syllabus. This means that candidates are expected to be able to describe how to carry out these procedures in a safe manner and answer any questions that pertain to standard practical techniques.

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. Care should be taken when deciding if a value is given to the correct number of significant figures or decimal places.

It is essential that candidates take time to ensure that their written work is legible. All questions should be attempted and sufficient time allowed for the completion of all of the tasks.

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

General comments

Candidates demonstrated a strong overall performance on the paper, consistently providing clear and concise answers. They demonstrated a good level of understanding of the invertase practical task and generated some good results tables and conclusions.

The excellent planning for the heat loss investigation highlighted a solid grasp of practical skills. This was emphasised by the thorough responses for the conclusion in Question 1 and the description of results and data presentation in Question 2.

Furthermore, the accurate plotting of graphs and calculations of size demonstrated a high level of understanding of the paper's requirements and the necessary skills.

When instructed to draw a biological specimen, candidates should dedicate sufficient time to fully observe all of its features. This keen observation is a critical component of practical biology.

Comments on specific questions

Question 1

- (a) Almost all candidates were able to name a suitable piece of equipment that is used to measure temperature, although care should be taken with the spelling of scientific terms.
- (b) The production of a suitable table to record the results from the investigation was done very well, with appropriate table structure and suitable headings. The inclusion of units in the body of the table was the most frequent error, with many choosing to put a percentage sign in the column for invertase concentration.

- (c) The conclusion for any investigation should be based on the original stated aims, as described at the start of the question. In this question, a link was needed between the concentration of the enzyme used (invertase) and the breakdown of sucrose into reducing sugars. Many candidates simply described the results, rather than attempting to state the relationship between enzyme concentration and sucrose breakdown.
- (d) A large proportion of candidates found this question challenging. Some managed to identify the test-tube containing distilled water as a control for the investigation but few were able to explain the purpose of having a control. A common mistake was to simply restate the contents of the test-tube rather than describing its use as a method of finding out if the sucrose was breaking down as a result of some other variable.
- (e) The identification of the independent variable was done well but confusion with the dependent variable was seen in some cases. It was also noted that some candidates combined variables, stating for example that the independent variable was the concentration of invertase when it was mixed with sucrose solution at 40°C for 15 minutes. In order to gain a mark, just the independent variable needed to be stated.
- (f) For this question, candidates were asked why the test-tube containing the mixture of enzyme and substrate was placed in a warm water-bath. The reaction had already started, so the water-bath was not therefore used to equilibrate the solutions. This would only be true if the solutions had not yet been mixed and we needed them at the same temperature.
- (g) The idea of contamination was generally well understood with most candidates describing how the remains of one of the previous solutions could affect the solutions added to subsequent test-tubes. Some answers lacked detail and simply stated that it was to make the volumes more accurate. References to the removal of dirt or pathogens was not accepted.
- (h) Good answers were seen but an attempt should be made to learn the correct spelling of scientific and technical terms. Confusion with a burette was not accepted.

Question 2

- (a) (i) Overall, candidates were able to identify two variables that were kept constant during the investigation. Marks were missed for several reasons. Firstly, temperature, although it may have been maintained for the duration of one experiment, was later changed as this was the independent variable. Secondly, answers tended to lack sufficient detail. Some candidates simply stated that time was kept constant, without describing which period of time they meant. Others stated that the yeast was kept constant, without identifying what aspect of the yeast they were referring to, such as concentration or volume.
- (ii) The identification of sources of error in this investigation was answered reasonably well. Sufficient detail should also be included – stating exactly what the source or error is rather than just saying ‘counting the bubbles’ for example. Some good descriptions of the use of a gas syringe were seen.
- (b) (i) Most candidates were able to calculate the rate of bubble production at the specified temperature, but there was some confusion with significant figures and decimal places.
- (ii) The graph was particularly well done with neatly plotted points and good presentation of data.

A few points to bear in mind for candidates who did not gain full marks:

- Axes must be linear and fully labelled with suitable values. This includes values on the x-axis or y-axis that include the final plotted point. In this case, the y-axis should not have stopped at 40, as one of the plotted points was at 41.
- The x-axis and y-axis do not have to start at zero. If they do not, the starting value must be shown.
- All plotted points should be of a small size, ideally drawn as a small neat cross or a small dot in a circle.
- The line joining the points must not be extrapolated in either direction.
- A line of best fit can be drawn, but in this case, it had to be a curved line of best fit which would go through all of the points. A straight line of best fit was unsuitable for this data.

- The question asked for the rate of bubble production to be plotted. Plotting the number of bubbles was not awarded marks.
- (iii) Some clear and concise descriptions of the results were seen from many candidates, with the trend stated and the optimum temperature identified. An explanation for the trend was not required.
- (c) It was clear that a good proportion of candidate had learnt the test for carbon dioxide using limewater.

Question 3

- (a) (i) The drawing of the head of the king penguin was done very well, with some good clear drawings. The size was usually adequate, and all lines tended to be thin and unbroken. A few candidates did not observe some of the features carefully and missed out a few important lines around the beak and neck. Shading and stippling was also sometimes seen on the body of the bird.
- (ii) The calculation of the actual length of the penguin's beak was very well done with full marks obtained by many candidates. A significant number of candidates misread 46 mm on the ruler as 41 mm. The use of decimal places appeared to be understood by most.
- (b) Some very good comparative points were seen between the head of the gentoo penguin and the head of the black-footed penguin. Despite being told not to, some candidates compared the sizes of the heads of the two birds.
- (c) This question asked candidates to plan an investigation to determine the effect of an insulator on heat loss in model penguins. The majority of candidates clearly understood the task fully and were able to describe some excellent methods. In most cases the dependent and independent variables were identified, and a number of relevant variables that should be kept constant were included. Methods were well laid-out with suitable descriptions of repeats. It must be remembered that safety precautions should be relevant to the task being described, and justification for their use should be possible.