BIOLOGY

Paper 0610/11
Multiple Choice (Core)

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

General comments

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

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

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

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

Comments on specific questions

Question 1

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

Question 4

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

Questions 13

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

Question 16

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

Question 17

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

Question 19

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

Question 23

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

Question 29

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

Question 32

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

BIOLOGY

Paper 0610/12
Multiple Choice (Core)

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

General comments

There was a good understanding of the use of food tests, tropic responses, and the use of dichotomous keys.

There was some uncertainty about the structure of the eye and direct disease transmission.

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

Candidates need to read the questions carefully (for example **Question 36** and **Question 37**) and interpret graphs precisely (such as in **Question 28**).

Comments on specific questions

Question 4

Most candidates could correctly identify which class of arthropod a crab belonged to although some incorrectly thought that crabs were arachnids.

Question 9

There was some confusion over whether active transport needs energy from respiration or occurs across a membrane.

Question 11

Some candidates could not identify the effect of temperature on enzyme activity, the most common incorrect response was option **B**.

Question 12

Some candidates were unaware that enzymes are not used up in reactions.

Question 19

There was a misconception that protease acts in the gall bladder rather than the stomach.

Question 20

Some candidates thought that transpiration is driven by osmosis or active transport.

Question 23

Most candidates could describe anaerobic respiration but some thought both lactic acid and carbon dioxide are produced.

Question 24

Many candidates incorrectly thought that the urethra is the organ responsible for the excretion of urea rather than the kidney.

Question 26

A few candidates thought that adrenaline decreases the diameter of the pupil.

Question 30

Some candidates were unclear about the function of the acrosome. Some thought the acrosome is needed for movement or that it stores genetic information.

Question 32

Most candidates knew that HIV is a pathogen but some thought that it was a bacterium.

BIOLOGY

Paper 0610/13
Multiple Choice (Core)

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

General comments

There was a good understanding of secondary sexual characteristics, flower structure and the effects of deforestation.

The was some uncertainty about the transport of amino acids in stems and roots and enzyme action.

Candidates need to look at diagrams carefully (such as **Question 17**) and it is important for candidates to work methodically through information provided in questions (such as **Questions 11 and 30**).

Comments on specific questions

Question 6

Although many candidates could manipulate and substitute into the magnification formula, some incorrectly tried to change the units and so selected option **C**.

Question 8

Many candidates were unaware that diffusion can occur without the presence of a membrane.

Question 11

Although most candidates knew that 35 °C was the temperature with the highest rate of starch digestion, many did not know which pH value would give the highest rate.

Question 15

Most candidates could identify the organs of the digestive system.

Question 18

Some candidates thought that the stomach or the gall bladder absorbs the most water.

Question 21

Many candidates did not realise that both fatty acids and glycerol are the products of fat digestion.

Question 27

Most candidates knew water and carbon dioxide are the products of aerobic respiration in plants, but some incorrectly believed that carbon dioxide and lactic acid are the products.

Question 28

Many candidates believed that the urethra excretes urea rather than the kidney.

Question 30

Some candidates could not interpret the diagram and incorrectly chose option **D** which is the antibiotic the bacteria are least resistant to.

Question 34

Many candidates incorrectly thought that ABO blood groups are an example of continuous variation.

Question 40

Some candidates did not realise that being able to make complex molecules is an important feature of bacteria in biotechnology.

BIOLOGY

Paper 0610/21
Multiple Choice (Extended)

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

General comments

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

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

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

Comments on specific questions

Question 5

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

Question 9

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

Question 12

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

Question 17

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

Question 22

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

Question 23

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

Question 28

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

Question 32

Some candidates incorrectly thought that stem cells were gametes.

Question 35

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

Question 38

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

Question 40

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

BIOLOGY

Paper 0610/22
Multiple Choice (Extended)

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

General comments

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

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

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

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

Comments on specific questions

Question 8

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

Question 13

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

Question 20

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

Question 22

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

Question 24

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

Question 30

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

Question 31

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

Question 34

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

Question 40

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

BIOLOGY

Paper 0610/23
Multiple Choice (Extended)

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

General comments

There was a good understanding of cell structure and functions, processes involved in digestion, and biodiversity.

There was some uncertainty about the role of the villus, components of blood and how the cholera toxin causes diarrhoea.

Candidates should be able to link diagrams of structures to their function (such as **Questions 16** and **18**).

Candidates need to read the questions (for example **Questions 19** and **37**) and interpret diagrams carefully (such as **Questions 7, 8** and **30**).

Comments on specific questions

Question 5

Some candidates thought a decrease in surface area would increase the rate of diffusion perhaps confusing this with diffusion distance.

Question 6

Candidates should be familiar with the terms used in the syllabus. Some candidates confused plasmolysed and turgid.

Question 16

Only a few candidates could identify the xylem in an image of a plant root and then link this to the xylem's function of structural support, instead many chose transport of assimilates.

Question 18

Only a few candidates could identify the image of the lymphocyte as the component of blood that produces antibodies. A similar number of candidates chose option **A**, a phagocyte.

Question 23

A common misconception was shown here, with many candidates believing that urea is produced in the nephron in the kidney.

Question 27

Many candidates were unaware that blood is not exchanged between the mother and the placenta and incorrectly chose option **B**.

Question 30

A few candidates were able to interpret this pedigree diagram correctly. The allele for white fur is recessive and so any white mice must be homozygous.

Question 37

Some candidates were able to sequence the steps of eutrophication, but some were unaware that it is the increase in aerobic respiration of decomposers that causes the reduction in dissolved oxygen.

BIOLOGY

Paper 0610/31
Theory (Core)

Key messages

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

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

General comments

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

Comments on specific questions

Question 1

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

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

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

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

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

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

Question 2

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

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

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

(ii) Some candidates knew the term active site.

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

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

Question 3

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

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

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

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

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

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

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

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

Question 4

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

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

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

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

Question 5

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

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

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

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

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

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

Question 6

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

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

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

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

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

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

Question 7

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

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

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

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

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

BIOLOGY

Paper 0610/32
Theory (Core)

Key messages

Candidates should read all questions carefully. They should ask themselves whether they have answered the actual question, as although the information they have given may be factually correct it may not answer the question.

Candidates should learn the biological definitions as they are shown in the syllabus.

General comments

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

Comments on specific questions

Question 1

(a) (i) Many candidates gave the correct word equation for photosynthesis.

(ii) Many candidates gave the correct name for the pigment. It is important to read the question carefully so that the name of the pigment is given, rather than its location.

(b) (i) This question was well answered. There were a few errors due to reading from the wrong axis.

(ii) Most candidates correctly determined the rate of photosynthesis from the graph.

(iii) To be awarded both marks, candidates needed to refer to the whole curve of the graph, as well as the peak or optimum.

(c) (i) This question needed to be read carefully. The question asked how starch is used by potato cells, but some answers were about food.

(ii) Few answered correctly. Many of the answers were substances not made from glucose.

(iii) Some candidates were unsure about ions and most answers were elements rather than ions.

(d) Some candidates confused the water and nitrogen cycles with the carbon cycle and so named incorrect processes.

Question 2

(a) (i) This question was well answered with many candidates clearly explaining the importance of physical digestion.

(ii) This question was not well answered with some candidates confusing physical and chemical digestion.

(b) (i) Most candidates could identify a molar tooth, but some confused the canine and the incisor.

(ii) Most candidates could describe the function of molar teeth.

(c) Few candidates knew the parts of a tooth.

Question 3

(a) Candidates were familiar with xylem and phloem as vascular tissue, but they were often unclear about which one transports sucrose.

(b) Successful candidates read the paragraph as a whole process, rather than simply filling in gaps. It started with water uptake in the roots and ended with water loss from leaves.

Question 4

(a) This question asks for two things that ensure the one-way flow of blood. As a 'system of blood vessels' was in the question, candidates should not have given the names or types of blood vessel in their answer. Veins and arteries were common incorrect responses.

(b) (i) Candidates needed to give sufficient detail, such as an actual machine or pulse rate. Pulse unqualified was insufficient.

(ii) Most candidates correctly identified two correct conclusions.

(c) Many candidates found this question demanding. Many omitted their working and therefore could not be awarded partial credit if their final answer was incorrect.

(d) Most candidates understood the importance of reducing fat in the diet. Other risks were less well known.

Question 5

(a) (i) Few candidates gave a suitable definition of a gene.

(ii) Most candidates correctly named the nucleus.

(b) Many candidates correctly completed the calculation.

(c) (i) Careful reading was needed here. This was a demanding question as it was in two steps, first to find that person **1** was a female and then to give the correct sex chromosomes. Most answers gave genotypes or phenotypes.

(ii) Most candidates identified the correct number of people with albinism.

(iii) Most candidates could link the genotype with the correct phenotype.

(d) Many candidates found this demanding. Some did not separate the parental genotypes into gametes and therefore gave incorrect genotypes for the offspring.

Question 6

(a) (i) Many candidates correctly identified the bacterial cell structures.

(ii) Most candidates gave structures from the diagram, but a few gave structures found in a plant cell.

(iii) Many candidates were unfamiliar with the function of plasmids.

(b) The syllabus gives a clear definition of sustainable. Nearly all answers were about producing a source of energy that does not harm the environment, rather than sustainability.

(c) Many candidates gave clear descriptions of the effects of untreated sewage on river ecosystems.

Question 7

(a) (i) Few candidates knew the correct term for maintaining a constant internal environment.

(ii) Most candidates knew the location of testes and the function of the hormone it releases. Although most knew that insulin is involved in glucose metabolism, few knew that it decreases the blood glucose concentration. Some candidates were able to recall the functions of the two hormones.

(b) Few candidates gave blood as the means of transport for hormones.

(c) (i) Many candidates correctly compared nervous and hormonal control.

(ii) Most candidates correctly named a neurone in a reflex arc.

Question 8

Some candidates were unable to describe the functions of the plant parts. The function needed to be related to the correct male and female parts in plants only. Many candidates thought that pollination and fertilisation were the same thing.

BIOLOGY

Paper 0610/33
Theory (Core)

Key messages

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

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

General comments

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

Comments on specific questions

Question 1

(a) This was well answered with many candidates gaining all three marks. Some candidates thought that water was a solute; this was by far the most common incorrect answer. The other common incorrect answer was that water is produced by photosynthesis.

(b) (i) Generally very well answered with many candidates gaining both marks. Some put salt solution rather than water as the part representing the cytoplasm.

(ii) Some candidates were confused about the direction of the arrow.

(iii) The most common incorrect answer was diffusion despite it being given in the question.

(c) Most candidates correctly identified the cell wall, although some suggested the membrane.

Question 2

(a) Very few candidates correctly identified the chemical elements in the different biological molecules with many placing only one tick in each row.

(b) Most correctly identified amino acid, fatty acid and glycerol but many thought that glycerol was a component of glycogen. The question asked candidates to draw four lines, one from each small molecule, but some only drew three lines.

(c) (i) Although most candidates knew that excretion meant the removal of something, many were unclear about the details. Many put digestion rather than metabolism in the second gap.

(ii) Most knew that carbon dioxide was excreted by the lungs although some put mouth or nose.

(d) (i) Many candidates were unable to correctly match the structure with its function. **C** or **D** were often given as the structure that excretes excess water.

(ii) Many candidates were able to correctly identify the urethra.

(iii) Although most identified **C** as the bladder. Some candidates confused the bladder with the gall bladder.

(iv) There were a range of suggestions for the name of the blood vessel that removed blood from the kidneys and despite the question asking them to name the vein, some named an artery.

(e) Most candidates gained both marks.

Question 3

(a) (i) Most correctly identified the homozygous recessive individual but were less sure about the two heterozygous plants believing that there must be one homozygous dominant and one heterozygous individual.

(ii) Most candidates were able to say the gardener should select blue flowers, but many got no further. Many referred to the selection of pure breeding plants without explaining how they might do that. Although the idea of selective breeding was named or known, many candidates could not apply their knowledge to the given situation.

(b) Most were able to correctly complete the Punnett square, but some were confused by the phenotypic ratio.

(c) Many candidates found this demanding, and some gave random suggestions.

Question 4

(a) Some candidates were able to correctly identify the letters and name the structures in the heart, but fewer were able to match these to the correct functions. A common error was to get **T** and **W** the wrong way round.

(b) Most knew that veins have valves and gained at least one mark for this question. Some referred to function rather than structure.

Question 5

(a) (i) Although many got the idea of a stimulus and a response, few used the terms coordination and/or regulation.

(ii) Most knew that the brain and spinal cord were the two parts of the CNS.

(b) Many candidates were able to identify the stimulus and impulse. Many were confused about the names of the different neurones in the reflex arc and the name given to the junction between neurones.

Question 6

(a) Identification of the root hair cell as the site of water uptake was well known but few gained more than this one mark. The last space was often given as stomata.

(b) (i) Of those that realised they were being asked about the guard cells, some gave vague answers about substances (water, gas, oxygen, air or carbon dioxide) that may or may not enter or leave via the stomata. Some thought that they were being asked about the cell wall, the cell membrane or the stomata.

(ii) There were many marking points that could be awarded but few candidates could answer the question asked, that was how layer **K** was adapted for photosynthesis. Most referred to the palisade as having chloroplasts or chlorophyll for absorption of light, but few mentioned the proximity to air spaces or near the upper surface.

(c) (i) Most correctly calculated the mass lost.

(ii) The calculation proved demanding for many candidates. Some extracted the correct numbers from the table but then did the calculation incorrectly. The third mark was frequently missed as the final answer was not given to the nearest whole number.

(d) The question asked for the effect of temperature, so it was important to specify whether the temperature was increasing or decreasing. Many candidates wrote temperature causes mass loss rather than referring to the rate of transpiration.

(e) Despite being told in the question that the temperature was maintained, many candidates thought that the rate of transpiration would decrease because of a decrease in temperature. This question required a two-part answer, a comment about the rate of transpiration and another about the mass loss. Of those that correctly said that rate increased, only a few said that this would cause a greater loss in mass.

Question 7

(a) The question asked for a description of the data, not an explanation. It was well answered and most gained three marks for identifying at least three pieces of information from the graph. Correct data also gained a mark. Some candidates gave incorrect data.

(b) Most were able to identify three different components of a balanced diet. Naming three different vitamins or carbohydrates only scored one mark.

(c) (i) Candidates found this demanding, many repeating the word modification which was in the question. Very few were awarded the second mark for suggesting how this might be achieved.

(ii) This was generally well answered with most candidates giving two suitable examples. Some did not read the question correctly and gave ways of improving the nutritional value. Many of the examples given were achieved by selective breeding rather than genetic modification.

(iii) Many were able to state that bacteria reproduced rapidly and were very small or could be grown in a small space. Few mentioned the ability of bacteria to make complex molecules.

BIOLOGY

Paper 0610/41
Theory (Extended)

Key messages

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

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

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

General comments

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

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

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

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

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

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

Comments on specific questions

Question 1

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

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

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

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

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

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

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

Question 2

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

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

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

Question 3

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

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

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

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

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

Question 4

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

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

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

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

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

Question 5

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

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

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

Question 6

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

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

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

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

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

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

Question 7

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

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

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

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

BIOLOGY

Paper 0610/42
Theory (Extended)

Key messages

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

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

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

General comments

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

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

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

Question 1

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

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

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

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

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

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

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

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

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

Question 2

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

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

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

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

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

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

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

Question 3

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

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

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

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

Question 4

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

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

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

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

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

Question 5

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

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

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

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

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

Question 6

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

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

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

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

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

BIOLOGY

Paper 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. 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 descriptions and explanations. In **Question 5(b)(iv)** some candidates did not explain clearly why the population of krill might decrease and the population of leopard seals might increase.

Candidates should use the mark allocation and 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, three separate points must be made for full marks to be awarded.

General comments

Candidates did not seem to be familiar with protein synthesis. Answers to **Question 3(a)** were often vague and omitted the details of the process.

Candidates should always take time to read the questions carefully. In **Question 4(b)(i)**, some candidates wrote about genetic modification rather than selective breeding even though it was very clear from the question which of these two processes was required. **Question 5(a)** asked for the chemical equation for photosynthesis, but some candidates gave the word equation instead. **Question 6(a)** asked for the genus name of the boreal toad – a word given in the stem of the question. Some candidates misread the question and gave a group of animals, such as amphibia.

Comments on specific questions

Question 1

(a) Most candidates identified the nucleus (**A**) in the generalised animal cell in Fig. 1.1 and its function; with many also correctly naming the cell membrane (**C**) and its function in controlling the substances that can enter or leave the cell. Fewer described the function of the cytoplasm (**B**) as a place where chemical reactions take place. Very few described the function of mitochondrion (**D**) in sufficient detail to be credited. The best answer was aerobic respiration. Those who wrote 'releases energy' or 'provides energy' needed to add that this requires oxygen. Candidates who stated that the mitochondrion is the 'powerhouse of the cell' were not credited.

(b) (i) Most candidates explained how water moves into and out of cells by osmosis. Some stated that the movement is from a place outside the cell with a higher water potential to a lower water potential inside the cell. A few stated incorrectly that water moves 'down a concentration gradient' and 'from a low concentration to a high concentration'.

(ii) Candidates were presented with drawings of red blood cells that had been placed in different solutions. Most candidates identified that the top drawing showed red blood cells in plasma. Fewer identified the other two drawings correctly. The middle drawing showed red blood cells that had been in a very concentrated salt solution and the bottom drawing showed cells that had been placed in pure water.

(iii) Many candidates named haemoglobin as the molecule that combines with oxygen. Incorrect answers included plasma, protein, iron and carbon.

(iv) Fewer candidates identified the white blood cell in Fig. 1.2 as a phagocyte. Lymphocyte was given by many candidates, and some did not understand what type of answer was required here as they wrote a statement rather than the name of a type of white blood cell.

Question 2

(a) (i) Fig. 2.1 showed a spider plant. Some candidates identified features of monocotyledons that were visible in the photograph. Parallel veins in the leaves was the most common correct answer. Among many incorrect features given was long leaves. Some candidates used information from the question and stated that the plantlets were a feature of monocotyledons.

(ii) Many candidates described some advantages or disadvantages of asexual reproduction. The most common advantages given included the fact that asexual reproduction is fast and that it does not involve pollination with another plant. The disadvantages were sometimes not explained clearly enough to gain credit although many correctly stated that a lack of variation was a disadvantage. Answers often related this to disease instead of stating that plants produced by asexual reproduction are likely to be susceptible to new diseases or that a disease is likely to spread quickly through the whole population as plants all have the same genotype.

(b) (i) This question was well answered with many candidates explaining that the large amount of pollen produced by the hazel tree increases the chances of either successful pollination or pollen reaching the stigma for reproduction.

(ii) Some candidates were not familiar with the structures of a flower and so discussed pollen production or pollen grain properties rather than the adaptations of the stigma. Good answers included reference to the stigma of a wind-pollinated plant being feathery. Candidates also gained the mark by stating that the stigma hangs outside the flower. Some answers stated that the stigma 'hangs outside the plant' and these did not gain credit.

(c) Some candidates correctly described the process of cross-pollination, although often the level of detail given was insufficient. Often pollination was not described as the movement of pollen from anther to stigma and a significant number of candidates did not mention that cross-pollination must be between different plants of the same species.

(d) Candidates often did not outline the events after pollination in any detail. 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 credit. Often missing was the idea that the pollen tube grows from the pollen grain. There was also confusion over whether it was pollen or the pollen tube that reached the ovule. Few mentioned the male nucleus moving down the pollen tube or that fusion occurs between male and female nuclei, rather than male and female gametes. However, many candidates stated that a zygote is formed as one of the events that occurs after pollination.

Question 3

(a) Answers to this question were often vague and omitted the details of the process. 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 digestion of proteins.

(b) (i) Fig. 3.1 was a diagram showing an enzyme breaking down a substrate molecule and Fig. 3.2 showed what happens when a molecule, **D**, is introduced into the reaction mixture. Only the most able candidates explained that molecule **D** has a shape similar to the substrate (molecule **A**) and so is also complementary to the active site of enzyme 1. Some stated that there was reduced break down of molecule **A** but did not explain why that happened.

(ii) Fig. 3.3 showed a diagram of an enzyme after a change in its environmental conditions. Many candidates identified two changes that would cause denaturation of an enzyme. A common misconception was that a change in temperature would cause denaturation of an enzyme, when only an increase would achieve this and not a decrease.

Question 4

(a) Some candidates stated that new alleles are formed by mutation, but fewer could explain that it was because of a change in the base sequence of DNA or that ionising radiation or chemicals could cause it to happen. Some candidates gave answers involving sexual reproduction and random fertilisation producing new combinations of alleles and gained no credit.

(b) (i) This question was about selective breeding in wheat plants. Some candidates described the selecting of wheat plants with the desired features and then stated that these plants would be bred together. Few candidates went on to state that offspring from this cross with the desired characteristics would be selected and bred together. Candidates should be careful to state that this process is repeated for many generations rather than just writing the process is repeated. Some candidates chose to write about genetic modification rather than selective breeding suggesting that they had not read the question carefully.

(ii) Some candidates identified the conditions needed for germination although some gave light, soil, or nutrients as a required condition. None of these are required for germination so were not credited. Some candidates did not gain a mark for simply stating temperature or pH. The acceptable answers were a suitable temperature and a suitable pH.

(iii) This question asked for differences between natural selection and artificial selection. The most common differences given were the speed of the process and the source of the selective pressure with most candidates stating that some aspect of the environment is involved with natural selection but that humans are responsible for artificial selection. Some stated that for natural selection some individuals are better adapted to survive in their environment but did not state that this led to more reproduction. Most candidates identified that artificial selection involves human intervention for a desired outcome.

(c) Many candidates identified some benefits of growing wheat with increased pest resistance. Most often candidates stated that there would be less use of pesticides and increased crop yield. A few mentioned there would be less pollution or less spread of plant diseases.

Question 5

(a) There were many correct chemical equations for photosynthesis. However, some candidates struggled to balance the equation correctly. Again, candidates should be careful to read the question as some gave the word equation.

(b) (i) Almost all candidates completed the food web correctly.

(ii) Few candidates knew that the principal source of energy for biological systems is the Sun, many stated that it is the phytoplankton.

(iii) Some candidates interpreted the food web correctly although few received full marks. Some named the organisms rather than giving the number but were given credit if the names were correct.

(iv) Most candidates predicted and explained the most likely effect of a decrease in orca population size on the population size of krill and leopard seals. They stated that they would decrease and increase respectively, but failed to explain why this would be the case. Some did not read the question carefully and mentioned the effect of krill or leopard seals on the population of orcas.

(c) (i) Some candidates listed the chemical elements found in fats, but a common error was to give fatty acids and glycerol. Lipids and other compounds, such as lactic acid, were also given.

(ii) Few candidates explained correctly why harvesting krill for omega-3 fatty acids is more energy efficient than making use of seals. Some gained partial credit for comparing the position of the two animals in the food web. Many of those who stated correctly that energy is lost at each trophic level did not go on to give examples of how the energy was lost.

(d) Some candidates described the digestion and absorption of lipids in detail. Many scored marks for stating that lipase breaks down fats into fatty acids and glycerol which are absorbed in the villi of the small intestine. Only a few candidates mentioned that emulsification by bile is an example of

mechanical or physical digestion. It is not an example of chemical digestion as there is no breaking of bonds when fat is emulsified.

Question 6

(a) Almost all candidates gave the genus of the boreal toad as *Anaxyrus*. Some gave the species name and others did not read the question carefully and thought the question was about classification and gave a type of vertebrate, such as amphibia.

(b) Many candidates gave two reasons for decreases in population with climate change, loss of habitat and increase of predators being the most common answers. Many of these candidates gave their answers as simply predators so did not gain credit.

(c) (i) Many candidates correctly calculated a percentage and gave the answer to two significant figures. Candidates should carefully read these calculation questions as a small number tried to calculate a percentage change which was not asked for.

(ii) Some candidates described the positive effect of the bacteria on the toads, resulting in a reduction in the number of toads infected, but few gave details from Table 6.1 to support their answers.

(d) (i) There were some good answers that described the purpose of conservation programmes in preventing extinction, but few candidates gave other reasons for conservation programmes such as the search for new drugs and genes that could be incorporated into domesticated plants and animals. Conservation programmes also aim to increase biodiversity and the stability of fragile habitats.

(ii) Few candidates described the process of artificial insemination in detail. The most common mark awarded was for the collection of sperm. Some saw the need for screening or freezing, but most suggested that the sperm was placed inside the female and did not specify that it needed to be placed in the vagina or uterus at the time of ovulation.

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 their working carefully and take time to consider whether the resulting answer is realistic.

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

General comments

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

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

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

Comments on specific questions

Question 1

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

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

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

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

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

Question 2

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

Question 3

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

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

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

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

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

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

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

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

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

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

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

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

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

BIOLOGY

Paper 0610/52
Practical Test

Key messages

Candidates should ensure that the working is shown in calculations. The working is particularly important where the question is worth more than one mark as some credit can be given for the steps in the calculation or for an error carried forward. The working should be clear and legible.

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

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

General comments

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

Comments on specific questions

Question 1

(a) (i) Most candidates were awarded this mark for calculating the final volume of the solution.

(ii) The vast majority recorded a suitable temperature value.

(iii) Many candidates were able to draw a suitable table that accurately represented the data they collected. The most common error was to omit correct units in the table headings. Candidates should not include units in the body of the table.

(iv) The majority of candidates were able to state a valid conclusion based on the results they found. To gain the marking point, they needed to understand that as the concentration of hydrochloric acid increased, the rate of diffusion also increased.

(v) To be awarded the mark, candidates needed to understand that the test-tubes all experienced the same temperature drop or that they were in the same water-bath. This proved challenging for many.

(vi) Most candidates were able to provide a correct answer as to why the hydrochloric acid was removed from the test-tube. Any reference to stopping the reaction or making it easier to measure were accepted.

(vii) Some candidates find naming the independent and dependent variables challenging. Most were able to identify the concentration of hydrochloric acid as the independent variable, although vague responses of just acid were not accepted. A larger number found it difficult to accurately name the dependent variable as the height of the yellow agar. Just stating agar was not enough for the marking point.

(viii) Most candidates were able to identify hydrochloric acid as a corrosive or hazardous substance that could cause harm or damage to the eyes.

(b) (i) Most candidates were able to correctly calculate the volume of the cube with a side length of 4 mm as 64 mm^3.

(ii) Candidates performed well on this graph question. Many demonstrated that they could accurately draw a suitable line graph to represent the data. A line graph is used to represent continuous data and the scales should be even. Some candidates plotted points that were too large to gain credit. Plotted points should be smaller than one small square on the grid. When drawing a point-to-point line, it is very important that candidates do not extrapolate this line past the data points.

(iii) It was evident that many candidates had experience of how to estimate a value from a graph line. Candidates are reminded that they should indicate on the graph how they determined their value.

(iv) Most candidates were able to identify two variables that needed to be controlled in this investigation. The most common correct examples were concentration of acid and temperature. A few incorrectly named variations of the independent variable, such as size of the agar cubes.

Question 2

(a) (i) Candidates produced some very good drawings of the seedling. Most were able to draw a suitable outline, although this was demanding for some. The outline should be clear and continuous. Only a small number of candidates drew a seedling that was too small. The most demanding part of the drawing was the first detail marking point. The two outermost leaves on the seedling needed to be drawn curved as shown in the photograph.

(ii) Most candidates were able to correctly measure the length of line **AB** in mm. A small number of measured in cm but did not change the unit given to match their measurement. Some candidates missed marks as they did not show the working. Providing the working and the calculated value in the space for working is important, as a mark for rounding correctly to two significant figures can be awarded even if the calculated value is incorrect.

(iii) This question proved challenging from some candidates. The question required candidates to identify a similarity and two differences in the photograph of the two seedlings. The most frequent similarity credited was the presence of a root-like structure that was pointing downwards. Many candidates were able to identify that there was a shoot-like structure on **P**, but not on **Q** and this was credited as a suitable difference. When making a comparison, it's important for candidates to note which seedling has the identified difference. For example, **P** has leaves and **Q** has no leaves.

(b) Most candidates were able to recall the tests for starch and reducing sugar. It was not uncommon for full marks to be awarded on this question. A common error was not including the fact that heat is needed for the Benedict's test.

(c) This planning question required candidates to apply their knowledge of phototropism in plant tissues to various light intensities. Some candidates designed experiments to measure the effect of different angles of light on the growth of the plant rather than the effect of light intensity. It was important that candidates suitably described both the need for different light intensities and how to achieve this difference. Candidates that discussed putting the plants at different distances from a lamp to change the light intensity, were credited with two marking points. Many candidates did not give a suitable description of controlled variables. Simply stating water is not enough. Instead, candidates should make it clear that the volume of water is kept the same for all plants. When discussing the need to repeat the experiment, it's important that it is repeated at least two times (three trials) in the same conditions.

BIOLOGY

Paper 0610/53
Practical Test

Key messages

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

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

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

General comments

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

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

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

Comments on specific questions

Question 1

(a) (i) The presentation of data was well done with most candidates gaining at least three marks. A significant number of candidates missed a mark for putting units in the body of the table, or for not including units at all. A few candidates measured in inches, which is not an SI unit of length and is not accepted.

(ii) Most candidates were able to describe the link between catalase activity and the type of plant tissue tested. The most common reason for not gaining the mark was to describe the relationship in terms of height of foam and to simply describe the results rather than stating a conclusion in terms of enzyme activity. To construct a valid conclusion, candidates need to consider the aim of the investigation and use the underlying science behind any dependent variable measurement.

(iii) Candidates were asked to state the independent variable. Some candidates found this demanding, with a description of a controlled variable being a common incorrect answer.

(iv) The majority of candidates were able to identify two variables that were kept constant during the investigation. Ambiguous statements were not accepted, for example, the amount of plant tissue was insufficient as amount could refer to mass, and the mass of apple and potato would probably be

different. A named reagent, hydrogen peroxide for instance, was also insufficient as candidates needed to refer to a property of that reagent, such as volume or concentration.

(v) Many candidates were able to identify the error, but fewer were able to give a suitable improvement.

(vi) Many candidates were able to identify the risk associated with cutting plant tissue and the use of hydrogen peroxide. However, as a method of reducing risk, candidates needed to give more detail, rather than simply stating that they should be careful, or get an adult to help.

(b) Most candidates who knew the reagent to test for vitamin C also knew the result of a positive test. It is important that candidates learn, and use, the testing reagents for biological molecules outlined in the syllabus.

(c) The plan was reasonably well done with a good range of marks awarded. A common mistake was to try to use the previous investigation as a starting point and add pieces of potato to amylase. Most candidates were able to suggest a suitable temperature range, and many gave suggestions for ways of obtaining these temperatures. Fewer candidates were able to state what was actually being measured, but some went down the route of using Benedict's reagent to measure the sugar produced, or iodine solution to measure starch loss. The controlled variables were identified by most, but many forgot to mention the need to do several replicates.

Question 2

(a) (i) The drawing of the egg case of a stick insect was reasonably well done, but a significant number shaded their drawing. Candidates should be reminded to only draw outlines. It is also important that candidates attempt to copy any visible patterns as closely as possible, and not just make up a similar design. When a drawing is reasonably large, marks will not be awarded for size if it goes into any of the text on the page. A few candidates drew the full egg case in Fig. 2.2 rather than the top part in Fig. 2.1 as instructed.

(ii) The measurement of length and subsequent calculation was straightforward for most candidates. A few forgot to round their answer to the nearest whole number.

(iii) Although many candidates were able to give some very clear and concise descriptions of the differences between the two egg cases, a few lacked clarity. Simply stating that they are different shapes, for example, was insufficient; a description needed to refer to the species and clearly state how they differed.

(b) (i) This question required candidates to work out a cm scale in 2 mm divisions and to determine a consistent point at which to take a measurement on that scale. Few candidates were able to do this, with many getting the scale wrong and assumed the divisions were 1 mm wide.

(ii) This question required candidates to recall the equation for the volume of a cylinder and then use the values in **2(b)(i)** to calculate the volume of oxygen used by the stick insect. Many candidates were able to gain both marks here. The question highlights the need for candidates to be aware of the mathematical requirements of the syllabus.

(iii) Many candidates were able to convert their value from **2(b)(ii)** into mm^3 per minute. A few attempted to convert to mm^3 per second, even though the units were given on the answer line.

(c) (i) Few candidates gained all four marks for the graph. The central issue was the scale used to plot the values for rate of oxygen use. For many of the scales seen, the plotted points occupied less than half of the grid. Candidates need to be aware of this scaling requirement and attempt to find a suitable scale for the points plotted. This may mean that they are not starting at zero when plotting points. The values need to be plotted as small points or crosses with a neat line of best fit or lines joining the points. Some plotted points were too large, and some lines were extrapolated or poorly drawn. Generally, the labelling of the axes was very well done, with most candidates carefully copying the titles from the table headers.

(ii) Candidates should be careful when deciding where to draw the line on their graph for the estimation of rate of oxygen use. Some gave values that were not consistent with the line drawn, or incorrectly identified the position of 18 °C on the *x*-axis.

BIOLOGY

Paper 0610/61
Alternative to Practical

Key messages

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

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

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

General comments

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

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

Comments on specific questions

Question 1

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

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

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

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

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

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

Question 2

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

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

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

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

Question 3

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

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

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

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

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

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

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

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

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

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

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

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

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

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Key messages

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

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

General comments

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

Comments on specific questions

Question 1

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

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

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

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

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

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

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

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

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

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

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

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

Question 2

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

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

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

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

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

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Key messages

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

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

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

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

General comments

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

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

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

Comments on specific questions

Question 1

(a) (i) The presentation of data was well done with most candidates gaining at least two marks. A common error was the recording of the height, with some candidates measuring the total height including the hydrogen peroxide solution in the test-tube. Only the height of the foam was required. A significant number of candidates missed a mark for putting units in the body of the table, or for not including units at all. A few candidates measured in inches, which is not an SI unit of length and is not accepted.

(ii) Most candidates were able to describe the link between catalase activity and the type of plant tissue tested. The most common reason for not gaining the mark was to describe the relationship in terms of height of foam and to simply describe the results rather than stating a conclusion in terms of enzyme activity. To construct a valid conclusion, candidates need to consider the aim of the investigation and use the underlying science behind any dependent variable measurement.

(iii) Candidates were asked to state the independent and dependent variable. The dependent variable was well answered, but many candidates found a description of the independent variable more challenging, with a description of a controlled variable being a common incorrect answer.

(iv) The majority of candidates were able to identify two variables that were kept constant during the investigation. Ambiguous statements were not accepted, for example, the amount of plant tissue was insufficient as amount could refer to mass, and the mass of apple and potato would probably be different. A named reagent, hydrogen peroxide for instance, was also insufficient as candidates needed to refer to a property of that reagent, such as volume or concentration.

(v) Although the foam in Fig. 1.2 was drawn to show it as uneven, many candidates found it difficult to identify this as a possible problem when measuring the height. Candidates who have actually done similar experiments in lessons are likely to have a much greater awareness of any possible issues with measuring the height of the foam.

(vi) Many candidates were able to identify the risk associated with cutting plant tissue and the use of hydrogen peroxide. However, as a method of reducing risk, many candidates needed to give more detail, rather than simply stating that they should be careful, or get an adult to help.

(b) Most candidates who knew the reagent to test for vitamin C also knew the result of a positive test. It is important that candidates learn, and use, the testing reagents for biological molecules outlined in the syllabus.

(c) The plan was reasonably well done with a good range of marks awarded. A common mistake was to try to use the previous investigation as a starting point and add pieces of potato to amylase. Most candidates were able to suggest a suitable temperature range, and many gave suggestions for ways of obtaining these temperatures. Fewer candidates were able to state what was actually being measured, but some went down the route of using Benedict's reagent to measure the sugar produced, or iodine solution to measure starch loss. The controlled variables were identified by most, but many forgot to mention the need to do several replicates.

Question 2

(a) (i) The drawing of the egg case of a stick insect was reasonably well done, but a significant number shaded their drawing. Candidates should be reminded to only draw outlines. It is also important that candidates attempt to copy any visible patterns as closely as possible, and not just make up a similar design. When a drawing is reasonably large, marks will not be awarded for size if it goes into any of the text on the page. A few candidates drew the full egg case in Fig. 2.2 rather than the top part in Fig. 2.1 as instructed.

(ii) The measurement of length and subsequent calculation was straightforward for most candidates. A few forgot to round their answer to the nearest whole number.

(iii) Although many candidates were able to give some very clear and concise descriptions of the differences between the two egg cases, a few lacked clarity. Simply stating that they are different shapes, for example, was insufficient; a description needs to refer to the species and clearly state how they differ.

(b) (i) This question required candidates to work out a cm scale in 2 mm divisions and to determine a consistent point at which to take a measurement on that scale. Few candidates were able to do this, with many getting the scale wrong and assuming the divisions were 1 mm wide.

(ii) This question required candidates to recall the equation for the volume of a cylinder and then use the values in **2(b)(i)** to calculate the volume of oxygen used by the stick insect. Many candidates were able to gain both marks here. The question highlights the need for candidates to be aware of the mathematical requirements of the syllabus.

(iii) Many candidates were able to convert their value from **2(b)(ii)** into mm^3 per minute. A few attempted to convert to mm^3 per second, even though the units were given on the answer line.

(c) (i) Few candidates gained all four marks for the graph. The central issue was the scale used to plot the values for rate of oxygen use. For most scales seen, the plotted points occupied less than half of the grid. Candidates need to be aware of this scaling requirement and attempt to find a suitable scale for the points plotted. This may mean that they are not starting at zero when plotting points. The values need to be plotted as small points or crosses with a neat line of best fit or line joining the points. Some plotted points were too large, and lines were extrapolated or poorly drawn. Generally, the

labelling of the axes was very well done, with most candidates carefully copying the titles from the table headers.

(ii) Candidates should be careful when deciding where to draw the line on their graph for the estimation of rate of oxygen use. Some gave values that were not consistent with the line drawn, or incorrectly identified the position of 18 °C on the *x*-axis.