

BIOLOGY

Paper 0610/11
Multiple Choice (Core)

Question Number	Key
1	B
2	A
3	D
4	B
5	C
6	B
7	C
8	A
9	A
10	C

Question Number	Key
11	D
12	B
13	D
14	B
15	C
16	A
17	C
18	C
19	A
20	B

Question Number	Key
21	B
22	A
23	B
24	C
25	C
26	C
27	B
28	A
29	C
30	D

Question Number	Key
31	A
32	C
33	D
34	A
35	B
36	B
37	D
38	B
39	C
40	C

General comments

There was a good understanding of cell structure, the sites of hormone production, plant tropisms, antibiotic use, and asexual reproduction.

There was some uncertainty about the transport systems in both animals and plants, the location of enzyme action and sexual reproduction in humans.

Candidates need to take the time to consider diagrams carefully, for example in **Questions 12 and 24**, and it is important to work methodically through information provided in questions, for example **Questions 10, 14, 19 and 22**. Many candidates were confident in answering questions that contained graphs, for example **Questions 13, 38 and 39**.

Comments on specific questions

Question 3

Many candidates were unclear about the features of mammals. Some thought that dolphins have gills rather than lungs and others were unaware that mammals produce milk.

Question 5

Some candidates incorrectly chose option **A** thinking that the function of cilia is to absorb oxygen.

Question 10

Most candidates could interpret the results of tests for biological molecules, but some could not interpret the results of the tests for carbohydrate.

Question 12

Many candidates could not interpret the diagrams of an enzyme, a substrate, and products. Some chose the products, option **D**, which is not possible for a digestive enzyme.

Question 14

A minority of candidates did not link the change in indicator colour showing a decrease in carbon dioxide concentration to photosynthesis, instead choosing respiration.

Question 21

While many candidates could identify that amylase acts in the mouth, some candidates incorrectly thought that amylase also acts in the stomach rather than in the small intestine.

Question 22

Many candidates did not realise that the xylem is found in a vascular bundle.

Question 30

The parts of an insect-pollinated flower were not well known with many candidates choosing stigma and anther as the parts of the carpel.

Question 34

Many candidates incorrectly thought that the zygote is a ball of cells rather than a fertilised egg cell.

Question 35

Most candidates thought that a sperm cell would contain XY chromosomes to produce a male offspring rather than just a Y chromosome.

BIOLOGY

Paper 0610/12
Multiple Choice (Core)

Question Number	Key
1	A
2	D
3	C
4	D
5	D
6	C
7	A
8	B
9	D
10	D

Question Number	Key
11	B
12	B
13	B
14	A
15	A
16	A
17	B
18	B
19	A
20	A

Question Number	Key
21	C
22	D
23	A
24	C
25	B
26	B
27	D
28	D
29	D
30	A

Question Number	Key
31	D
32	D
33	D
34	B
35	C
36	B
37	A
38	A
39	A
40	A

General comments

There was a good understanding of the structure and function of the cell, types of teeth, identifying red blood cells and their function, and methods of HIV transmission.

The was some uncertainty about gas exchange, interpreting biological molecule tests and the structure of a stem.

Candidates need to take the time to consider diagrams carefully, for example **Questions 23 and 39**, and it is important to work methodically through information provided in questions, for example **Questions 7, 21 and 37**. Many candidates were confident in answering questions that contained graphs, for example **Question 26** and many had clearly learned and understood the information in the syllabus, for example **Questions 6, 12, 29 and 38**.

Comments on specific questions

Question 7

There was some confusion about applying the principles of gas exchange to a frog. Some had the directions of diffusion of oxygen and carbon dioxide reversed or that both would show net diffusion from the frog.

Question 10

Some candidates could not identify the positive result of a biuret test with a few confusing the positive result of the Benedict's solution test or the iodine solution test.

Question 11

Some candidates could not identify the third element found in fats along with carbon and hydrogen. Some chose iron or nitrogen.

Question 20

Some candidates knew that water is reabsorbed in both the colon and the small intestine, but a significant number thought this occurred in the small intestine or the large intestine only.

Question 21

Some candidates incorrectly thought that starch could be transported in the phloem and some incorrectly identified the xylem as the phloem.

Question 23

Some candidates could correctly identify the valve in the diagram as evidence that the vessel is a vein, but a significant number thought that the blood flowing upwards was the evidence.

Question 27

Some candidates did not know the order of neurones in a reflex arc, confusing motor neurones and relay neurones.

Question 31

The conditions required for germination were not well understood with many candidates selecting light.

Question 37

While many candidates understood that the allele for red was dominant, some thought the offspring were homozygous.

Question 39

Some candidates chose option **C**, perhaps confusing a pyramid of numbers with a pyramid of biomass.

BIOLOGY

Paper 0610/13
Multiple Choice (Core)

Question Number	Key
1	C
2	C
3	C
4	C
5	A
6	C
7	B
8	C
9	C
10	A

Question Number	Key
11	C
12	D
13	D
14	A
15	A
16	C
17	B
18	C
19	C
20	A

Question Number	Key
21	A
22	C
23	B
24	B
25	B
26	D
27	A
28	C
29	C
30	B

Question Number	Key
31	B
32	B
33	A
34	A
35	C
36	C
37	B
38	D
39	B
40	A

General comments

There was a good understanding of the characteristics of living things, features of vertebrates, interpreting representations of an enzyme and its substrate, the position of groups within a food chain, and identifying phases in a graph of population growth.

There was some uncertainty about transport in both animals and plants, the structures of wind-pollinated and insect-pollinated flowers and how sex is inherited in humans.

Candidates should be able to use descriptions of terms in the syllabus, for example **Questions 7 and 24**.

Candidates need to ensure they read the question carefully, for example **Questions 3 and 19**.

Comments on specific questions

Question 3

Few candidates could apply their knowledge of arthropod groups to answer this question correctly. Candidates should know the key features of these groups including the usual patterns for the number of legs found in each group.

Question 8

Most candidates knew that diffusion does not require energy from respiration, but a few incorrectly believed that diffusion must occur across a cell membrane.

Question 10

There was a lack of understanding of the different tests for biological molecules. Many candidates incorrectly thought the sample contained starch despite a negative result with iodine solution.

Question 16

Some candidates confused the anus with the rectum.

Question 17

Candidates struggled to apply their knowledge of the functions of the parts of the alimentary canal to this example.

Question 19

Many candidates incorrectly thought that water molecules move by active transport from a mesophyll cell to the air spaces.

Question 20

Many candidates were unsure about the blood vessels going to and from the lungs and the kidney. More candidates could identify the pulmonary artery than the renal vein.

Question 29

Some candidates thought that anthers are located inside wind-pollinated flowers. Candidates need to be able to identify both wind-pollinated and insect-pollinated flowers.

Question 31

There was a lack of understanding of the inheritance of sex in humans. Most candidates thought that both X and Y chromosomes are found in a human sperm cell instead of either an X or a Y chromosome.

Question 34

Many candidates correctly realised that an ecosystem could contain all three types of energy transfer listed. A significant number did not realise that energy transfer 3 is a description of a carnivore eating an animal, and so incorrectly choose option **B**.

Question 38

Few candidates knew how herbicides increase food production with some confusing herbicides with insecticides and fertilisers.

BIOLOGY

Paper 0610/21
Multiple Choice (Extended)

Question Number	Key
1	C
2	C
3	B
4	A
5	A
6	D
7	C
8	C
9	D
10	D

Question Number	Key
11	C
12	A
13	C
14	B
15	C
16	C
17	C
18	A
19	D
20	B

Question Number	Key
21	B
22	A
23	C
24	D
25	B
26	C
27	B
28	D
29	C
30	D

Question Number	Key
31	C
32	C
33	A
34	A
35	A
36	B
37	C
38	A
39	D
40	A

General comments

There was a good understanding of the use of dichotomous keys, the names of structures in the digestive system and the description of a drug.

The was some uncertainty about the roles of hormones in pregnancy and how to apply knowledge of the nitrogen cycle to a new context.

Candidates need to take the time to consider diagrams and graphs carefully, for example **Questions 7 and 14**.

Candidates need to ensure they read the information given in questions carefully, for example **Questions 17 and 35**.

Comments on specific questions

Question 7

Most candidates could interpret the graph correctly, but a few incorrectly thought the potato cells would be flaccid or plasmolysed.

Question 9

Few candidates realised that enzyme molecules will continue to increase in kinetic energy as temperature rises even after they are denatured.

Question 11

Many candidates confused scurvy with rickets and incorrectly chose option **A**.

Question 14

The structure and function of the villus was not well understood with many candidates incorrectly thinking that amino acids are absorbed through the lacteal.

Question 17

Only the leaf was exposed to the radioactive carbon which was shown clearly on the diagram. However, some candidates incorrectly believed that the results showed that the growing tip was a source as well as the leaf.

Question 19

Some candidates were not familiar with the features of a vein, incorrectly choosing option **B** with included a small lumen.

Question 20

Most candidates realised the component of blood drawn was a white blood cell, but many incorrectly identified the component as a lymphocyte. Candidates are expected to be able to identify blood cells from images.

Question 22

While most candidates knew that the diaphragm contracts to increase the volume of the thorax, fewer knew the role of the internal intercostal muscles.

Question 24

There was a common misconception that urea is formed in the kidney rather than the liver. Many candidates incorrectly chose option **C**.

Question 33

While most candidates knew that xerophytes have a thick cuticle as an adaptive feature for living in an environment with low water availability, a significant number thought that xerophytes would have many stomata.

Question 35

Many candidates incorrectly chose option **B**. Candidates need to carefully read the question as these candidates chose a pyramid of energy rather than the pyramid of numbers as required by the question.

BIOLOGY

Paper 0610/22
Multiple Choice (Extended)

Question Number	Key
1	A
2	B
3	D
4	C
5	B
6	D
7	A
8	C
9	B
10	C

Question Number	Key
11	C
12	B
13	C
14	D
15	C
16	A
17	B
18	B
19	C
20	C

Question Number	Key
21	C
22	D
23	A
24	B
25	C
26	D
27	C
28	C
29	C
30	D

Question Number	Key
31	B
32	B
33	B
34	D
35	D
36	D
37	C
38	D
39	C
40	C

General comments

There was a good understanding of how species are named, the functions of cell structures, DNA base pairing rules, defences about pathogens, and coronary heart disease risks.

The was some uncertainty about the structure of synapses, the development of antibiotic resistance, and the nitrogen cycle.

Candidates need to take the time to consider diagrams and graphs carefully, for example **Questions 10, 32 and 38**.

Candidates need to ensure they read the information given in questions carefully, for example **Questions 34 and 36**.

Comments on specific questions

Question 6

Some candidates did consider the units given carefully, and so incorrectly chose option **A** rather than option **D** which was correctly converted from mm to μm .

Question 7

There was a misconception about the direction of movement of water, with most candidates thinking that water would move by osmosis from **Q** to other cells which is the opposite direction.

Question 26

Many candidates could correctly identify the neurones in the synapse and the direction that the transmitters moved.

Question 27

Most candidates could describe the responses of the iris muscles to moving into a dim area, but some candidates selected option **B** which described the opposite responses.

Question 29

Some candidates believed that artificial selection is a part of the development of antibiotic resistance in bacteria. However, this is an example of natural selection as humans are not selecting for antibiotic resistance as a desired characteristic.

Question 31

Few candidates understood that all cells in the human body contain the same genes, but different cells express different genes. Most candidates incorrectly believed that the DNA sequence varied between cells in the human body.

Question 33

There was a common misconception that DNA is made from amino acids.

Question 34

Some candidates did not read the question carefully and so calculated the energy lost between producers and primary consumers rather than secondary consumers.

Question 35

The processes in the nitrogen cycle were not well known with few candidates correctly identifying nitrogen fixation as the process that removes nitrogen gas from the atmosphere. Many candidates believed that it was denitrification.

Question 38

Most candidates could calculate the percentage increase, but a few divided by the final value rather than the initial value.

BIOLOGY

Paper 0610/23
Multiple Choice (Extended)

Question Number	Key
1	C
2	D
3	A
4	C
5	A
6	B
7	A
8	A
9	A
10	A

Question Number	Key
11	C
12	B
13	C
14	A
15	A
16	B
17	A
18	A
19	C
20	C

Question Number	Key
21	B
22	D
23	D
24	D
25	D
26	C
27	C
28	B
29	C
30	C

Question Number	Key
31	C
32	A
33	A
34	B
35	B
36	B
37	B
38	A
39	D
40	C

General comments

There was a good understanding of how species are named, active transport, and enzyme activity.

The was some uncertainty about plant cell structure and leaf structure, locations of enzyme action and how fish stocks can be conserved.

Candidates need to take the time to consider diagrams and graphs carefully, for example **Questions 10** and **35**.

Candidates need to ensure they read the information given in questions carefully, for example **Questions 19** and **39**.

Comments on specific questions

Question 3

Few candidates identified the diagram as a cell from a root despite the lack of chloroplasts.

Question 7

Many candidates did not understand that the shape of the active site of an enzyme needs to be complementary to the substrate rather than the same shape as the substrate.

Question 11

Some candidates correctly chose the row with enzyme, substrate, and the site of enzyme action. Some candidates did not realise that fatty acids are the products rather than the substrate of lipase and others did not realise that trypsin acts in the small intestine rather than in the stomach.

Question 16

Some candidates incorrectly believed that antibodies stimulate an immune response.

Question 19

While most candidates were able to identify the substances that are filtered from the blood in the glomerulus, some incorrectly chose option **D** which is the components of urine after reabsorption.

Question 24

Most candidates could identify where a pollen tube forms.

Question 25

This question highlighted a common misconception about the conditions required for germination. Some candidates selected option **C**, low light intensity, which would not prevent germination.

Question 31

Many candidates were not sure about how red-green colour blindness is inherited despite it being a named example in the syllabus of a sex-linked characteristic.

Question 32

This question required candidates to understand the term pure-breeding which is described in the syllabus. Some candidates instead gave the ratio of offspring that result from breeding two heterozygous plants.

Question 35

Many candidates chose option **C**, which would be represented by the balanced chemical equation for respiration which is the reverse of the balanced chemical equation given in the question.

Question 36

Many candidates were confused between the stationary phase and the lag phase in this question and so incorrectly selected option **C**.

BIOLOGY

Paper 0610/31
Theory (Core)

Key messages

Candidates need to read each question carefully, as there is often information in the question that must be used in the answer. Candidates often see one or two words and write everything they know about that topic, much of which does not answer the question and cannot be credited.

Command words such as 'describe', 'explain', 'suggest' and 'compare' require different responses from candidates. If a description is required for a question that includes a graph or a table, then it is 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' questions.

General comments

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

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

Comments on specific questions

Question 1

(a) The answers the first three rows; cell membrane, cell wall and cytoplasm, were the most common correct responses. Some candidates were unaware that the nucleus was only present in the animal cell and the plasmid was only present in the bacterial cell, opting instead for E or J. Occasionally the cell wall was identified as the cell membrane and some candidates thought both had cell walls. The plasmid was often identified incorrectly.

(b) Very few candidates named the process as respiration and those that did often did not specify aerobic. Some candidates thought that mitochondria produce energy which is incorrect. Mitochondria release energy.

(c) Many candidates were awarded full marks. When two marks were awarded, it was usually for the correct identification of the flagellum and jelly coat. Candidates found identifying the energy store and enzymes in the acrosome more challenging. Many candidates thought that both cells contained an energy store.

Question 2

(a) Most candidates knew the term 'carnivore' but not 'third trophic level'. Many identified a turtle as a herbivore perhaps thinking that a sea cucumber is a plant. Many seemed to have overlooked the direction of the arrow between small fish and sea urchin.

(b) (i) Very few gave an answer which mentioned energy, most answers were related to feeding or eating or nutrition.

- (ii) Some candidates made up a food chain of random animals unrelated to the question. Others did not notice the five-organism requirement and instead gave four organisms or just copied part of the web.
- (iii) Few candidates correctly named photosynthesis. Incorrect answers included solar and respiration.
- (iv) Most were able to correctly suggest decomposer, detritivore was also accepted. Incorrect answers included carrion and microorganisms.

(c) Those candidates that grasped the concept that overharvesting would reduce the number of large fish generally went on to score two marks. Some thought that the numbers of large fish increased. Some were less explicit with the first marking point and did not always make it clear that there would be fewer large fish for the sharks to feed on. A few candidates did write about the impact on the small fish and algae, but this was far less frequently seen. Some candidates gained two marks for stating that sharks ate fewer large fish and more turtles although most did not go any further than this. Some did not seem to understand the term overharvesting.

(d) The most common correct answers were reproduced and environment. Those gaining three marks also usually got the mark for natural selection. The term 'alleles' was more challenging. Common incorrect responses were offspring or variation or inheritance.

Question 3

(a) Many candidates did not give observable features from the image and focused on things they knew rather than what was visible. Candidates imagined a colour photograph of this plant and referred to green leaves and chlorophyll or were very descriptive about leaf and stem shapes rather than features specific to photosynthesis such as being thin and having a large surface area.

(b) (i) Many candidates simply repeated the stem of the question by referring to the gases being exchanged. Diffusion and carbon dioxide entering the leaf via the stomata were the most frequent answers. There was limited knowledge of the spongy mesophyll cells and air spaces. Most were able to identify and state a function of stomata/**B** and guard cells/**C**. Several thought that guard cells were involved in the selection of what entered or left the leaf.

(ii) Many found this demanding. Common incorrect answers were water, carbon dioxide, vitamins, and chloroplast.

(c) Many mentioned phloem and/or xylem rather than the vascular bundle. The rest of the question was quite well answered.

Question 4

(a) A full range of marks were awarded with many getting three or four marks. The most common incorrect answer was that **Q** produces sperm.

(b) (i) Those candidates that were not awarded this mark said the sperm increased in length but did not refer to the decrease shown in the graph.

(ii) Most candidates gave a correct value. Incorrect answers included 50, 60 or 68 μm .

(iii) Most candidates gave the correct answer.

Question 5

(a) Very few correctly identified either the larynx or the capillary, most choosing words from the next question. **F** was often identified as the trachea and **G** as the alveoli.

(b) Most candidates were awarded two marks, but some inverted the bronchus and bronchiole.

(c) (i) The composition of inspired and expired air was well known.

(ii) Few candidates knew that limewater is used to test for carbon dioxide. Some incorrectly stated hydrocarbon indicator.

(d) (i) Most candidates gave an incorrect answer such as anus, bladder, large intestine, urethra.

(ii) Most correctly identified urea and water. Many thought the third answer was mucus instead of ions.

Question 6

(a) (i) Candidates found this definition demanding. Many had an idea of what it was but could not put it into words. Many thought that variation was about changes in an organism rather than differences between organisms. Few gained the second marking point for saying the differences were between individuals of the same species.

(ii) Many candidates were unfamiliar with the terms 'continuous' and 'discontinuous' variation.

(iii) Some candidates correctly identified the graphs as showing discontinuous and continuous variation but did not give an example of each. It should be noted that the inheritance of human iris colour is complex and does not fit easily into either category, so it is not a good example of either type of variation.

(b) The first marking point was the best known. The final answer was the least likely to be correct and chemical, sun or solar were frequent incorrect answers.

Question 7

(a) (i) Most candidates gave correct years. The most common incorrect answer was 1700 to 1900.

(ii) Generally, most were awarded the mark, but some referred to increase as growth.

(iii) Most candidates gave a correct year. The most common incorrect answer was 1700.

(b) A range of marks were seen but very few achieved full marks. Some referred to pollution or focused on oxygen reduction. The responses were often unclear.

(c) Most could give at least one way in which humans damage aquatic environments. Of those that did not gain the mark, many did not give responses that were relevant to aquatic environments.

Question 8

(a) Of those that did not gain all three marks, the most common was to miss the link to 'breaks down nutrient molecules'.

(b) Generally, this was well answered.

(c) The calculation proved demanding. Despite the formula being supplied many chose to use their own formula. Others lost a mark for rounding incorrectly. A common incorrect answer $0.016 \text{ cm}^3 \text{ per s.}$

BIOLOGY

Paper 0610/32
Theory (Core)

Key messages

Candidates need to read each question carefully, as there is often information in the question that must be used in the answer. Candidates often see one or two words and write everything they know about that topic, much of which does not answer the question and cannot be credited.

Command words such as 'describe', 'explain', 'suggest' and 'compare' require different responses from candidates. If a description is required for a question that includes a graph or a table, then it is 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' questions.

General comments

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

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

Comments on specific questions

Question 1

- (a) Many candidates gained both marks here, the best responses ended their label lines clearly in the middle of each structure.
- (b) Many candidates incorrectly chose thick and wide for the artery and thin and narrow for the vein. Some candidates had not read the question properly and circled thick/thin or wide/narrow.
- (c) Many different answers were given here, not all were part of the circulatory system.
- (d) (i) Heart was the most common correct answer. Lungs and heart were often the wrong way round. The brain was frequently given as the answer for **A**. Kidney was seen less frequently for answer **C** with liver being the most common incorrect answer.
- (ii) More candidates got this wrong than right, usually by drawing the arrows from **A** to **B** for the pulmonary artery and from **B** to **A** for the pulmonary vein but there were also arrows drawn on all parts of the diagram.
- (e) Most candidates correctly gave capillaries. Common incorrect answers included arteries, veins and other named blood vessels.
- (f) Most correctly identified carbon dioxide and urea. However, glucose and oxygen were also seen.

Question 2

- (a) Some candidates missed marks by ticking the two correct options but then ticking a further box, and in some cases a further two boxes.

(b) (i) Candidates demonstrated good skills in being able to apply their understanding and accurately read the correct pH from the graph.

(ii) Most candidates could use the given data to select a suitable value. Most of the correct answers given were pH 5.3 indicating the point where the two lines intersect.

(iii) Most candidates were again able to read off the graph to select a suitable value from the possible ranges. The most frequent correct answer was pH 10. Very few gave answers in the 0 to 4 pH range.

(iv) Many candidates did not know that protease is found in the stomach or that it breaks down proteins. Many gave the small intestine as the location. Candidates need to know the locations where enzymes are produced.

(v) Some candidates misinterpreted the question and read it as what is produced by the salivary glands rather than linking it to the enzyme produced by the salivary glands. This meant that many answers referred to saliva as the product. A significant number seemed unfamiliar with the terms 'substrate' and 'product'.

(c) Most candidates gave the correct answer. The most common incorrect answer was physical digestion.

(d) Most candidates knew that temperature affects enzyme activity.

Question 3

(a) (i) Many were able to identify photosynthesis as **Q** and combustion as **R**. Incorrect answers for photosynthesis were transpiration and absorption. Generally, other incorrect answers included decomposition, evaporation and condensation. Fewer were able to correctly identify process **S** as feeding with some referring to it as respiration.

(ii) The most common incorrect answers showed the arrow going the wrong way and the reverse of the **S** arrow.

(b) Few candidates gained this mark. The most common incorrect responses referred to nitrogen or, oxygen.

(c) Most candidates were able to suggest planting more trees. Some gave ways to reduce the production of carbon dioxide (e.g. reduce burning of fossil fuels) rather than positive ways to remove carbon dioxide from atmosphere.

(d) Nearly all candidates were able to give at least one chemical element all proteins contain. Some candidates did not seem to know what an element is and gave examples of molecules such as amino acids, enzymes or proteases.

(e) There were very few correct answers because most did not refer to energy.

Question 4

(a) Many candidates were able to identify two correct features of fish; usually scales, fins, or gills. Some did not understand the question and instead gave suggestions such as 'use a key', 'use its genus name'. There was no mention of swim bladder or lateral line.

(b) The syllabus definition of population was clearly stated by some candidates. Some candidates described the number of species rather than the number of individuals in a species. The idea of area and time together were not always clearly expressed. Candidates need to be able to recall definitions given in the syllabus.

(c) (i) Most candidates completed this question by drawing three lines and were awarded full marks. A few answers linked **C** to the death phase.

(ii) Many were awarded at least one or two marks. Candidates linked some ideas to general causes of population change and not to the data given for the fish population. A good range of answers from all the marking points were seen.

Question 5

(a) (i) Some candidates were not able to calculate the rate. Often answers were given with no indication of how the answer had been calculated. Some did not state their answers to two decimal places. Many candidates used the gaps in the data to guess an answer of 0.12 mm per second following patterns in the data.

(ii) Many candidates did not know the direction the bubble would move, and some did not recall precisely enough where processes occurred in the cellular structure of the leaf. Candidates need to ensure they are familiar with the expected results of practical work. Few responses gained full marks. Most gave decreased, fewer gave distance, mesophyll and stomata or stoma. However, nearly all incorrectly gave beaker, ruler or capillary tube for the last response.

(iii) Temperature and humidity were the most frequent correct answers.

(b) Many gained at least one mark. Photosynthesis and support were the most common correct answers. Growth was a common incorrect answer. Keeping the soil moist was often stated.

(c) Some candidates were able to give a clear and full definition of an organ. However, many gave answers that were too vague and did not link tissues to a specific function that the organ would perform. The idea that there is more than one tissue in an organ was often missed, instead cells or groups of cells were mentioned.

Question 6

(a) Some candidates were able to calculate the correct percentage increase. Of those that did not, many gained mark point one for correct data selection but were unable to correctly calculate the percentage increase as they had divided the difference by 300 instead of 120. Some candidates did not show their working potentially missing out on a marking point if their final answer was incorrect.

(b) Most candidates were able to gain at least one mark either by stating that disease could spread more easily or for identifying animal welfare concerns. Pollution, slurry and waste were common responses. Very few candidates mentioned antibiotics being routinely used.

(c) Although many candidates identified that the desirable trait was laying more eggs, some stated quality rather than quantity and others just stated desirable features rather than referring to the context in the question. Most candidates recognised that you had to breed the chickens together, but few appreciated that the process should be repeated over many generations instead using phrases such as many times or many years.

(d) The majority of candidates achieved two marks. Where one was missed it was for doubling up on the fertiliser answer, usually with manure or soil improvement which were considered to be the same point. Some suggested planting more seeds or cultivating more land. The use of fertilisers, pesticides or herbicides were the most common methods stated. Some candidates correctly wrote about genetic modification, irrigation, and drainage.

Question 7

(a) Most candidates could explain that more juice was produced with pectinase. Some candidates were unable to read correct figures from the graph. When quoting figures, the units must always be included.

(b) The components of a balanced diet were well known.

(c) Few candidates gained two marks. The most common correct answers were the rapid reproduction rate and the ability to make complex molecules.

(d) Most gained at least one mark here, usually for 'changes the genetic material of an organism.'. The most common incorrect answer was 'involves sexual reproduction.'

Question 8

- (a) (i)** Many candidates did not give features of gas exchange surfaces, instead they named structures such as the lungs, alveoli and bronchi. Of those that identified the features, most used an appropriate adjective to describe the feature such as large surface area, good blood supply.
- (ii)** Many candidates were able to correctly identify the correct organ system, but many referred to the lungs as an organ system.
- (b)** Most candidates attempted to give a word equation with the majority gaining at least one mark. Many confused aerobic respiration and photosynthesis. Those who gave a symbol equation needed to get it completely correct. Some gave an = symbol instead of an arrow showing the direction of the process.
- (c)** Many candidates were able to explain that muscles move or contract but were unable to correctly make the link between high respiration rate and the release of energy. Many referred incorrectly to energy being produced or made.

BIOLOGY

Paper 0610/33
Theory (Core)

Key messages

Candidates need to read the question carefully, as it often contains specific information that must be used in the answer. Candidates often see one or two words and write everything they know about that topic, much of which does not answer the question and cannot be credited.

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

General comments

Candidates should be familiar with the proper biological meanings of terms and avoid using everyday language. They should also take care with meanings of words such as thick, thicker and thickest. Candidates should not give a list of possible answers, as only the first answer will be taken.

Comments on specific questions

Question 1

(a) (i) Most candidates understood that the movement of oxygen molecules would be from a high to a low concentration, but they did not refer to the difference in numbers of molecules in the diagram. A few candidates just repeated the stem of the question, diffusing from outside to inside.

(ii) A few correct responses were seen but this proved challenging for many. A common error was to state that the energy for diffusion comes from respiration.

(b) (i) The majority of candidates gave the correct response.

(ii) Not all candidates gave haemoglobin as the molecule.

(c) This question was generally well answered.

(d) A common error was to refer to cells rather than to particles or molecules. Although many recognised the need for energy, they did not mention respiration as the source of energy. Many candidates did not recognise the difference between diffusion and active transport and repeated their answer to **Question 1(a)(i)**.

Question 2

(a) Most were able to indicate where egg cells develop and where implantation occurs, fewer were able to identify where fertilisation occurs.

(b) Candidates should always use appropriate scientific terms. Many seemed uncertain of the difference between a zygote and an embryo.

(c) (i) Candidates needed to look carefully at the graph to answer this set of questions rather than trying to remember days. This question asked for the days when the lining is being lost not when it is at its thinnest.

(ii) The plateau on the graph is the time when the lining is thickest (same thickness), some candidates gave 8 to 22 which is when the lining is getting thicker.

(d) Generally, a well answered question, with most candidates giving the correct name and a suitable role.

Question 3

(a) (i) Most candidates remembered to round their answer to a whole number. Errors were made in the conversion or by not using the correct equation. It is important to show working as sometimes marks can be awarded for working even if the final answer is incorrect.

(ii) Generally, a well answered question. It is important to read the question carefully as a common error was to give parts of the body rather than processes.

(b) (i) Most candidates could correctly name the parts of the intestines in the diagram.

(ii) Generally, a well answered question, with most candidates realising that large molecules such as starch and fibre would not be absorbed into the blood.

(iii) Most candidates identified organ **W** as the stomach and were able to give appropriate functions. Many correctly gave the production of hydrochloric acid for killing microorganisms or providing a suitable pH, but a common error was to state the purpose of acid as breaking down food.

(c) Only a few candidates could name the process correctly.

Question 4

(a) (i) Some candidates did not recognise that structure **A** is everything in the circle so gave the names of individual cells rather than the whole structure.

(ii) Candidates often did not recognise the cell or the air space. Most attempted to give the roles of the structures.

(b) The majority of candidates recalled the correct word equation for photosynthesis, with only a few giving the word equation for respiration. Some gave symbols instead of words which were only accepted if the whole equation was correct.

(c) Many candidates gave details of the function of root hair cells, rather than how their shape enables them to absorb more water.

(d) Many candidates described responses in a tropical climate, rather than how tropisms help plants. Careful reading of the question was needed.

Question 5

(a) (i) Generally, a well answered question. It is important to take care reading the axes, for example the x-axis was sometimes misread as 10.5 rather than 15 s.

(ii) The majority gave the correct answers with only a few errors from reading the wrong axis.

(iii) Most candidates identified the correct statement.

(b) Generally, a well answered question. Some did not recall that mitochondria are the site of aerobic respiration.

(c) Movement was a common answer that was accepted, but many gave multiple examples of movement such as different types of exercise. Some focused on the characteristics of living things

rather than the uses of energy released from respiration which did not always result in a correct response.

Question 6

- (a) The majority of candidates realised that the STIs caused by bacteria could be treated with antibiotics. A few candidates gave a single name which was not enough for the mark.
- (b) (i) Few candidates were able to recall the correct definition of a drug.
- (ii) Most answers focused on the antibiotics rather the bacteria being resistant and some suggested that the body was becoming resistant.
- (c) Most candidates selected the two correct boxes.
- (d) (i) The majority of responses were correct.
- (ii) Most candidates could interpret the data correctly.
- (e) The majority of candidates demonstrated a very good understanding of the control of STIs.

Question 7

- (a) (i) Few recognised that touch was the stimulus. The most common answer seen was the pin.
- (ii) Although many candidates understood that the impulse travels from the sensory neurone onwards, the order of the neurones was often incorrect. However, many gave the correct muscle response.
- (b) (i) The pupil was correctly drawn by nearly all candidates.
- (ii) Many candidates knew that **A** was the iris.
- (iii) Many candidates correctly identified the structure as the retina. The most common incorrect answer was the cornea.

Question 8

- (a) Most candidates understood that producers make their own food, but few made the link with the Sun's energy or photosynthesis.
- (b) There were some good answers, but some processes given were not in the carbon cycle.
- (c) Candidates need to be clear about the meaning of words ending in '....cide'. A pesticide kills pests, so resistance to pesticides is not useful. Resistance to herbicides is useful as the farmer can spray crops to kill weeds, so reducing competition.

BIOLOGY

**Paper 0610/41
Theory (Extended)**

Key messages

Some questions require a description or an explanation. The best responses recognise the important points and link them together to give a clear logical account.

Some candidates were not able to gain full credit due to misinterpretation or lack of careful reading of the question. Candidates should use the correct scientific terminology when describing or explaining phenomena and also follow the instructions given in a question.

When a definition is asked for, candidates are expected to recall the description of the term as stated in the syllabus. Learning definitions also improves the precision of responses given in longer prose questions.

General comments

A good standard of biological knowledge and understanding was displayed by some of the candidates, who gave clear, articulate and accurate responses.

Many candidates showed good factual knowledge though they should be reminded to read the stimulus material provided carefully for each question and complete all the instructions contained within each question to help maximise their chance of success.

Some areas of the syllabus were better known than others. Candidates should be reminded to revise all the material detailed in the syllabus. The syllabus can be used as a revision tool.

Some candidates had a good understanding of biological processes and mechanisms, and they were generally able to communicate their responses clearly. There was evidence of a wide variety of knowledge and understanding of all parts of the syllabus and an ability to apply different skills depending on the question demand. Some candidates gave responses that did not answer the questions completely.

Comments on specific questions

Question 1

(a) (i) Candidates who did not gain full credit found it hardest to identify where gas exchange occurred, followed by the location of most photosynthesis. A few candidates did not follow the instructions in the question and gave names instead of letters, this was not credited.

(ii) Most candidates were able to identify the vascular bundle on Fig. 1.1.

(iii) This was generally well answered and many gained full credit. Candidates were asked to state two substances that were only moved by translocation. The majority of incorrect responses suggested substances carried in the xylem, rather than in the phloem, indicating perhaps that there was confusion between translocation and transpiration.

(b) The majority of candidates gained marks for stating that the function of xylem was water transport. Attempts to describe the absence of end cell walls, forming a long continuous tube and the absence of cell contents were often poorly expressed. The idea of thick walls was less well known. Stronger responses linked lignin to support.

(c) Most candidates were credited for xylem. Many mentioned root hair cells without stating that water entered them by osmosis, which was needed for the first marking point. Candidates frequently omitted the cortex cells between the root hair cells and the xylem. Many candidates knew about the forces of attraction between water molecules, or cohesion. Far fewer gained the related mark for a column of water molecules moving upwards.

Some candidates were confused about the movement of water in the leaf. Some stated that the spongy or palisade mesophyll were in the root or that water came in and left through the stomata. Others wrote about water reaching the air spaces without passing through the mesophyll cells. Many candidates did not identify the surface of mesophyll cells as the location of water evaporation.

(d) Very few candidates recognised that nitrates are required to make amino acids, which in turn make proteins. Most candidates gained credit for stating that nitrates or proteins were required for growth or photosynthesis.

Question 2

(a) (i) Many candidates gave the correct answer. Common errors were dividing the change by the final value (1600) instead of the starting value (3900). Another common error was using a two-step method to calculate the percentage which had not decreased (41) and giving that as the final answer, instead of continuing on to subtract 41 from 100 to give 59. The majority of candidates were able to round to two significant figures.

(ii) Many candidates gained two or three of the four marks available, usually by suggesting a combination of condoms, testing and education. Candidates referred less frequently to antibiotics or vaccinations, or the idea of avoiding transmission through blood. Vague references to protection were not credited.

(b) (i) Nearly all candidates correctly suggested the ovary.

(ii) Most candidates were able to refer to secondary sexual characteristics and identify some of the changes caused by oestrogen at puberty. A significant number of candidates explained the role of oestrogen in the menstrual cycle in terms of its effect on other hormones and the uterus, instead of recognising that it controls the start of menstruation.

(c) The majority of candidates were able to supply the first two missing words, although several candidates misunderstood the difference between antibiotics and antibodies. There was also much confusion between genes and alleles. The last four gaps were generally less well answered.

Question 3

(a) (i) This question was generally well answered with many candidates correctly identifying the prokaryote kingdom. A common incorrect response was bacteria.

(ii) Nearly all candidates gave movement or swimming and B for the first row and most candidates gave cell membrane and controls what goes in and out of the cell for the second. The final three rows were answered less well, and many candidates were unable to identify that plasmids are used by humans in genetic modification. The function or use of the cell wall was frequently mistaken for the cell membrane.

(b) Most candidates stated eating, drinking or ingestion, but fewer used the term contaminated in their response. Often responses repeated the term infection, which was in the stem of the question and was not a sufficient description of how a person becomes infected with cholera. Even though many candidates knew that cholera is water/food borne they often used too simple a term – omitting ‘to drink’ the water and some candidates incorrectly suggested it was transmitted by touch.

(c) There were some excellent responses for this question and several gained full credit, but most candidates showed a lack of understanding of how cholera causes dehydration. Almost all candidates explained that diarrhoea is the loss of watery faeces. The strongest responses described that the pathogen releases a toxin, that triggers chloride ion release. Candidates were expected to answer in terms of chloride ions lowering the water potential, but there were several that described the movement of ions as changing the concentration or diffusion gradient. Many gained credit as water was described as leaving the cell by osmosis. Common misconceptions included that the

cholera bacteria released the chloride ions, or that the bacteria used up all the water in the body, or that the bacteria had a direct effect on the kidneys.

(d) Generally, candidates displayed a good knowledge of how vaccination works. Occasionally there was some confusion between the terms antigen, antibiotics and antibodies. However, some candidates found this question challenging, with common reasons for not gaining credit including describing a vaccine as a weakened disease, stating that antibodies formed the memory cells and referring to the memory cells or antibodies fighting the disease, rather than killing the pathogen. Candidates should be reminded that antibodies bind to antigens and that they are specific. Most candidates showed a lack of understanding of the effect of mass vaccination on reducing person-to-person transmission of the pathogen.

Question 4

(a) Nearly all candidates wrote central in the first gap, but many were unable to give peripheral for the second gap.

(b) (i) Many candidates gained full credit for this question. Candidates who only gained one mark tended to get **S**, **Q** and **N** in the correct order, but not **P** and **M**.

(ii) Many responses referred to temperature, but candidates often found it difficult to identify a second stimulus. The most common second responses were touch, pressure or pain.

(iii) Many candidates correctly identified circular or radial muscle or the iris. Candidates need to be reminded of the difference between the roles of the circular and ciliary muscles. Ciliary muscle was a frequent response that did not gain credit.

(c) Some candidates were awarded full marks for this question. The majority of candidates gained credit for writing that neurotransmitters were involved, but the steps of the release of neurotransmitter from vesicles at the pre-synaptic or first neurone, diffusion across the synaptic gap and binding to receptor proteins on the post-synaptic or second neurone were not well known. Many candidates gave a description of a reflex arc, and the neurones involved which did not answer the question.

Question 5

(a) Candidates struggled to give clear responses to this question. Many recognised that it was about a sex-linked characteristic but did not state it clearly. Candidates who recognised that parent 2, the mother, was homozygous recessive for red-green colour blindness still found it difficult to explain why the male children would have to be colour-blind because they obtained the allele from the mother's X chromosome.

(b) Most candidates who gave the correct genotypes at the start achieved full marks. Candidates who did not use the X and Y chromosomes for the genotypes generally only gained the final mark for the probability.

Question 6

(a) This question was generally less-well answered, with many suggestions of bacteria, but a few gave plants or mammals.

(b) Most candidates either got full credit or no credit. Candidates should be encouraged to make the letters 'a' and 'o' very clear when writing 'lag' and 'log', as ambiguity cannot be credit.

(c) (i) The majority of candidates recognised that air is required for respiration, but not all went on to explain that the oxygen in air is required for respiration.

(ii) A few candidates stated that respiration releases heat. Most candidates wrote about enzymes and denaturation due to high temperatures and the need for an optimum temperature. Though several candidates incorrectly suggested that enzymes denature at high and low temperatures. Very few considered the effect of temperature on the yield of penicillin.

(iii) Many candidates recognised that the paddles were used to stir or mix the organisms, nutrients and air or oxygen. Candidates found it more of a challenge to express the idea of ensuring even

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distribution of these components. Very few recognised that the distribution of heat was also important.

(iv) The expected responses of insulin and mycoprotein were not seen very often. Many other answers were also accepted. Bread was a common incorrect answer.

BIOLOGY

Paper 0610/42
Theory (Extended)

Key messages

It is very important for candidates to understand what is expected by the command words 'describe' and 'explain'. These command words require different responses and understanding this was critical for answering **Questions 2(b) and 3(a)(ii)**.

It would be beneficial for candidates to practise the spellings of keywords, particularly in cases where they could get confused with another keyword. The spelling of bronchioles was important for **Question 2(a)(i)** and the spelling of glycogen and glucagon was of great importance for **Question 3(b)**.

It was clear that many candidates had a good scientific knowledge, however on occasion they needed to ensure that their knowledge was tailored to the specific context given in the question. There were many questions that involved more than a simple recall of knowledge and the skill lay in the application to the context given. **Questions 1(d)(i), 2(b), 5(b) and 5(d)** were examples where this skill was critical.

General comments

There was a high standard of scientific knowledge and understanding with many candidates providing detailed and accurate responses.

While many candidates had a broad knowledge of the syllabus, it was evident that some areas of the syllabus were better known than others. The syllabus can be used as a revision tool.

Comments on specific questions

Question 1

(a) The majority of candidates were able to give species as the correct additional information required to name an organism using the binomial system. Several candidates gave the term 'specie' presumably thinking this was the singular of species. Very occasionally incorrect responses were seen including genus and *Chlorella*.

(b)(i) A variety of incorrect cell structures were seen including cell membrane, cell wall and cytoplasm. The correct response of chloroplast was frequently seen with nucleus seen less frequently. It appeared that some candidates were not able to link the fact that prokaryotes do not possess membrane-bound organelles with the cell structures shown in Fig. 1.1.

(ii) This question was more successfully answered with a variety of correct cell structures seen. Very occasionally candidates included cell structures that were not visible in Fig. 1.1 such as ribosomes. These responses were not awarded credit.

(iii) Most candidates were able to state the correct names of the kingdoms. A minority gave the names for groups of vertebrates such as mammals and reptiles, while others gave bacteria and viruses.

(c)(i) This question proved demanding and required careful reading. The first step was to identify the correct values to use from Table 1.1. Candidates needed to identify that each tablet only contained 5g of *Chlorella* supplement to be able to calculate the correct number of tablets. For full credit, the value had to be given to one decimal place, a step that some candidates missed. Common

inaccuracies included trying to include the value of iron in the *Spirulina* supplement and incorrect rounding or truncating of values.

- (ii) It is important that candidates understand the meaning of the command words commonly used in questions. Some candidates simply described the data without any attempt at an explanation. Candidates were also specifically instructed to refer to the data in Table 1.1 to justify their answer. This was missed by some candidates. Some responses were too vague, simply referring to the *Chlorella* supplement having more nutrients. The best responses were able to link the importance of vitamin C and calcium to the relative values in the *Chlorella* and *Spirulina* supplements.
- (iii) The vast majority of candidates were able to give an appropriate dietary source of vitamin C. Both specific named examples as well as more general categories such as fruit or vegetables were acceptable.

(d)(i) A common misconception was that proteins provide the energy for active transport. Many candidates were able to give a definition of active transport, but fewer were able to link the role of proteins as protein carriers with active transport. During active transport, ions and molecules are transported against a concentration gradient.

(ii) The correct response of amino acids was commonly seen. Occasionally the chemical elements that proteins are composed of were given. The question required careful reading as it specified the names of the smaller molecules and not the elements that make up proteins.

Question 2

(a)(i) Candidates should be reminded that it is important to spell keywords correctly to avoid confusion with other biological terms. The spelling of bronchioles proved challenging for many. The intercostal muscles were often misidentified as the ribs and the bronchioles as the bronchus. The diaphragm was commonly misspelt as 'diaphram'.

(ii) Cartilage tissue was commonly seen as was its correct function. It was evident that some candidates confused the oesophagus with the trachea. Vague functions such as protection were not credited.

(iii) The question specified the cells that protect the breathing system from particles. Responses that included white blood cells were not credited. Another response commonly seen was cilia. This was also not credited as the question asks for the names of the cells.

(b) There were some excellent responses seen with some candidates successfully linking the events happening in the graph with their scientific knowledge to give an informed description and explanation. Some responses only gave a description of section **A** of the graph with no attempt at an explanation. It was important to recognise that the question specified a description and an explanation for section **A** of the graph only. Candidates that described and explained the whole graph contradicted themselves unless they specified which part of their response related to section **A** and which related to section **B**. However, many candidates were able to link the change in pressure and volume in the thorax to the mechanism of inhalation referencing the roles of the diaphragm, intercostal muscles and the ribs.

(c) An increase in carbon dioxide concentration of the blood was commonly given as the reason for an increased breathing rate. The organ of detection was less well known with some candidates referring to organs other than the brain such as the lungs and the liver. Some candidates reiterated in a variety of ways that rate of breathing would increase. Fewer identified that the depth of breathing would increase.

Question 3

(a)(i) Fluid **A** was sometimes misidentified as water. A very common incorrect response was to give the name of fluid **C** as urea instead of urine.

(ii) This question required a description and an explanation of the differences in the components found in the fluids listed in Table 3.1. Several candidates simply gave descriptions. The question instructed candidates to use the stimulus material to aid their responses. Candidates needed to refer to the differences in the values of the components of the fluids and give a reasoned explanation for these differences. A common misconception was that protein was selectively reabsorbed rather than being

too large a molecule to enter the Bowman's capsule. Many candidates recognised that all of the glucose was reabsorbed from fluid **B**. The best responses stated that protein was absent in fluid **B** and **C**, glucose was absent in fluid **C** and that the percentages of water, ions and urea increased in fluid **C** in addition to giving reasons for each of these differences.

(b) The spellings of keywords were important for this question. Glucose, glycogen and glucagon are similar in spelling but very different in their roles. The brain was often incorrectly identified as the organ that detects a change in blood glucose concentration. Most candidates were able to state the role of insulin in stimulating the conversion of glucose to glycogen in the liver. Fewer were able to correctly describe the role of glucagon. The best responses were able to describe the roles of the liver and pancreas organs and the insulin and glucagon hormones and how they control blood glucose concentration through the mechanism of negative feedback.

(c) (i) Some candidates partly repeated the question and described a change in the gene. Candidates needed to specify it was a change in the sequence of bases instead of simply stating a change of bases in the DNA.

(ii) The treatment of type 1 diabetes through use of injections of insulin was commonly known. Fewer candidates were able to give other methods of treatment such as controlling the intake of carbohydrates and monitoring blood glucose concentration.

Question 4

(a) (i) There were many vague descriptions of the term species, with many trying to describe species in terms of a group of organisms with similar DNA or characteristics. The term species has a specific biological meaning, which is stated in the syllabus. It is beneficial for candidates to learn the specific descriptions of terms that are in the syllabus.

(ii) It was necessary for candidates to include arrowheads to show the direction of the transfer of pollen from anther to stigma. Occasionally candidates labelled every structure in the flower, which was unnecessary, but not penalised. There was some inaccurate labelling with the style labelled as the stigma and the filament labelled as the anther. Occasionally the labels for pollination were drawn too short, suggesting the transfer of pollen was to the air; or too long extending down the style.

(iii) A variety of correct responses were acceptable with the site of fertilisation and contains the ovules commonly seen for **X**. The function of **Y** was more demanding with many candidates simply referring to protection. To gain credit there had to be reference to protection during the bud stage. Some candidates misread the question and stated the names of the parts instead of the functions.

(b) There were many detailed responses seen although some responses only described asexual reproduction. This question was about self-pollination and why it can result in sexual reproduction. The best responses recognised the involvement of haploid gametes resulting in fertilisation. The name of the female gametes in plants was often misremembered as ovum or egg cells instead of ovules.

(c) Most candidates could state an aquatic or water environment. Occasional incorrect responses included dry and warm. Inaccurate responses such as rainy, damp and moist were not credited.

Question 5

(a) Most candidates could identify that there were four people with XY chromosomes. The number of people that had only one **I^A** allele was much more challenging, with fewer candidates gaining this mark.

(b) There were a number of confused responses with many trying to explain in terms of inheritance or that discontinuous variation is caused by genes only. The question expected candidates to explain using Fig. 5.1 so any responses referencing bar charts versus line graphs were insufficient. The best responses identified there being only four blood groups with no intermediates as characteristics of discontinuous variation shown in the figure.

(c) It was evident that this question confused many of the candidates. Examples of discontinuous and continuous variation are clearly stated in the syllabus. Other correct examples that are not stated in

the syllabus were also accepted. A wide variety of incorrect responses comparing variation between species were seen instead of discontinuous variation within a species.

(d) This was a demanding question. Candidates needed to link their knowledge of codominance to this specific example. A general description of codominance was insufficient to gain credit. Candidates had to refer to the **I^A** and **I^B** alleles or the existence of the **AB** blood group in order to gain marks. There was some confusion about the difference between an allele and the blood group.

(e) This question was very well answered. Many candidates were able to complete clear genetic diagrams and include the correct percentage. Occasionally candidates tried to include both alleles in the gamete circles and it was clear there was some confusion between the meaning of the terms genotype and phenotypes.

Question 6

(a) The nitrogen cycle was a demanding topic for many candidates. A variety of incorrect answers were seen for the first box including air, microorganisms and decomposition. Nitrate ions were commonly known. Some candidates were imprecise and gave mineral ions, which was ignored. Bile or amino acids were often given in place of urea. Nitrification was often given in the place of denitrification.

(b) The synthesis of information across topic areas is an important higher-level skill. Many candidates were able to identify that decomposition occurred in both cycles. Fewer were able to give a second process. Those that did usually gave feeding or excretion although other correct examples were accepted.

(c) The majority of candidates identified the Sun as the principal source of energy.

BIOLOGY

Paper 0610/43
Theory (Extended)

Key messages

Careful reading of each command word is crucial in responding to a question appropriately. It is particularly important to distinguish 'explain' from 'describe' questions.

Candidates who use a bulleted list for long answer questions often use too few words to provide sufficient detail for their answer to be credited. They are reminded that more than a term or phrase will be required in each statement to ensure that the context is clear.

There are a number of key terms in the syllabus that can be easily confused. Examples include lipase and ligase, antigen, antibodies and antibiotics, vaccines and injections, and resistance and immunity. It is important that key terminology is used correctly.

Candidates are also encouraged to check that they have answered all the questions on the paper, including questions that involve labelling diagrams rather than written responses on answer lines.

General comments

There was generally a good understanding of physical digestion (**Question 1**), vaccination (**Question 3(b)(iv)**) and blood clotting (**Question 6(a)(ii)**). Candidates also showed good data manipulation skills (**Question 2(b)** and **Question 4(b)(ii)**) and were thorough in their description of experimental results (**Question 3(b)(i)**).

Explanations of graphical data (**Question 4(b)**) and trends in seasonal translocation (**Question 2(c)(i)**) were less well developed. Inconsistent notation for the codominant cross (**Question 5(c)**) highlighted misconceptions associated with the different types of genetic crosses.

Comments on specific questions

Question 1

(a) (i) Most candidates labelled the gall bladder as **B** and the liver as **A**. Common errors were to label the two organs the wrong way around or label the stomach as the organ that stores bile.

(ii) Many candidates knew that physical digestion involves the breakdown of food into small pieces with fewer going on to qualify this by stating that no chemical change would take place. The mention of large insoluble molecules being broken down to small soluble molecules was frequently seen. This did not gain a mark as this is a chemical change.

(iii) Almost all candidates knew at least one place where physical digestion occurs in the body, with many giving two correct places. Common incorrect answers were the teeth, trachea, ileum, liver and the large intestine.

(b) (i) Most candidates could complete at least some of the sentences about fat digestion. The most common error was to state that the stomach released bile.

(ii) The products of fat digestion were well known by almost all candidates. A common error was to confuse glycerol with glycogen or glucagon.

(c) Although many candidates gave detailed explanations of the role of bile in the breakdown of protein, a few wrote about emulsification or the use of bile to digest proteins.

Question 2

(a) (i) Although lots of correct visible features that classified the aphid as an insect were seen, many vague answers were not credited. These included jointed legs, antennae, and segmented body.

(ii) Almost all candidates correctly named **M** as the phloem. The most common incorrect response was **N**, but all other incorrect letters were seen.

(iii) Many candidates knew two nutrients transported in the phloem.

(b) Most candidates correctly selected the relevant numbers from the table to calculate the percentage change in the rate of translocation between the two temperatures. Many of these candidates went on to carry out the correct calculation and to give their answer to three significant figures. Common errors included using the incorrect denominator in the calculation, not giving the answer to three significant figures and incorrect rounding.

(c) (i) Few candidates were familiar with how translocation changes between spring and summer. Some candidates were unfamiliar with the terms source and sink and suggested this was to do with their depth in the soil. A common error was to mention that the shoot was the source in the summer rather than the leaves.

(ii) Asexual reproduction in potatoes was well known by almost all candidates. A common incorrect answer was mitosis.

Question 3

(a) Many candidates knew that breastfeeding would reduce the risk of transmitting HIV from the mother to their infant. Fewer candidates went on to give additional ways that the risk could be reduced, with most candidates describing general methods to reduce transmission between people, without considering which of these would be appropriate between a mother and their infant. A common vague answer was to mention the exchange of bodily fluids and others incorrectly suggested HIV vaccination.

(b) (i) Most candidates used the data in the table to describe the effect of breastfeeding on the chance of getting infections. Some very detailed answers were seen, but those who only quoted the numbers in the table and did not describe the effects were not awarded any credit. Others suggested explanations for the results even though this was not required.

(ii) Almost all candidates knew that white blood cells or phagocytes and lymphocytes are involved in the immune response.

(iii) The responses describing how infants gain passive immunity were very variable. Some very detailed answers were seen, but equally many candidates gave vague responses, often with features of active, rather than passive immunity. Others confused antibiotics, antigens with antibodies.

(iv) Many candidates realised that immunity gained by vaccination was active immunity and went on to give a comprehensive account of the differences between how it differs from passive immunity. Some candidates stated that vaccination was an artificial method of acquiring immunity, but this is not a difference from passive immunity, given that artificial passive immunity is also possible.

Question 4

(a) (i) Although many candidates knew that lactic acid was involved in anaerobic respiration, the word equation was not well known. Common errors included adding carbon dioxide, alcohol, or water as additional products. Some candidates also added additional substrates.

(ii) Most candidates could give at least one comparison between anaerobic and aerobic respiration. The most common correct responses referred to the differences in the use of oxygen, and the use of glucose in both processes. Some candidates knew extra details, such as differences in the location

within the cell of the two processes. The most common error was to describe differences in the production, rather than the release of energy.

(b) (i) More candidates knew that the organ that detects the stimulus is the brain than were able to identify the stimulus. The most common wrong answer was a change in the oxygen concentration.

(ii) Many candidates correctly calculated the rate of decrease in the heart rate between the two time points. The most common error was to misread the heart rate from the graph, but a number of candidates also carried out a percentage calculation.

(iii) This long response question asked candidates to explain the changes in the breathing and heart rate of the athlete as they recovered after running a race. Although most candidates did explain the results, a significant number only described the data, often quoting numerous data points from the graph, both before and after the race. Those responses seldom gained much credit. Of the candidates who did explain the results, the most common points made included reference to the formation of an oxygen debt and the respiration of lactic acid in the liver requiring additional oxygen. Some candidates incorrectly stated that there would be no energy requirement and no muscle contraction after the race, while others wrote ambiguous statements that made it impossible to know whether the process that they were describing was occurring during or after the race. This was commonly seen in responses written in bullet points where insufficient context was included in each bullet point.

Question 5

(a) Many candidates correctly stated that discontinuous variation is caused by genes only. Common incorrect answers included continuous variation and mutations.

(b) Many candidates stated all the possible genotypes for the two chickens in the pedigree diagram. Some candidates gave the phenotypes, rather than the genotypes, or put the alleles on X and Y chromosomes, even though the key for the two alleles was given in the question.

(c) Most candidates knew how to complete a genetic diagram with many scoring well in this question. Even those who made an error in one of the steps were able to gain credit for following the correct procedures using the error carried forward rule. Common errors included inconsistent use of symbols or carrying out a sex-linked cross.

(d) Although many candidates knew that the AB blood group was an example of codominance, a wide variety of incorrect examples were seen.

Question 6

(a) (i) It was quite common to see vague descriptions of inheritance with many candidates using the terms trait or characteristic rather than referring to the genetic material. Other candidates did not clearly describe the transmission from one generation to the next. Some candidates incorrectly described the transmission of infectious diseases between individuals.

(ii) Almost all candidates knew some of the steps in the process of blood clotting. Some excellent answers were seen, with candidates giving clear descriptions of the stages involved in the formation of blood clots. The final stage of trapping of blood cells in the mesh was least well described.

(b) (i) More candidates knew that **A** was a restriction enzyme than knew **B** was ligase. The latter was often described as 'combining' enzyme. Ligase or restriction enzyme were sometimes given for both enzymes, suggesting that they knew that these enzymes were involved but were unsure about their specific roles.

(ii) Many candidates referred to sticky ends in their explanation about why the same restriction enzymes are required to cut both the plasmid and the human DNA. Good explanations referring to these ends being complementary to each other were also commonly seen, although sometimes the idea referred to the enzyme being complementary to the substrate, rather than the two ends being complementary to each other.

(iii) Fewer candidates stated that **C** represented the recombinant plasmid.

- (iv) Some very detailed explanations of the reason for stirring the content of the fermenter were seen. Equally some candidates made vague references to mixing or the growth of the bacteria without any further detail.
- (v) All the points to describe why bacteria are useful in biotechnology were seen. Rapid reproduction rates and the limited ethical concerns were the most popular reasons, with the presence of plasmids and their small size meaning that not much space is required were also frequently seen. A few candidates mentioned that they can be used to make complex molecules, even though the question asked for reason other than this one. Other candidates gave vague answers, often describing bacteria as being easy to keep or grow. Other candidates misread the question and gave examples of the uses of bacteria in biotechnology.
- (vi) A wide range of correct differences for how animal cells differ from bacterial cells were seen. The most common points were the presence of a nucleus, and the absence of a cell wall or plasmids. Answers that did not gain credit often referred to the absence of cytoplasm or cell membranes in bacteria, or references to vacuoles or flagella. Flagella cannot be used as a difference since they are not found in all bacteria, and although the structure is different, the tail on a sperm cell is sometimes referred to as a flagellum. Candidates referring to vacuoles and chloroplasts may have confused plant cells with either animal or bacterial cells.

(c) Most candidates gave at least one advantage of genetic engineering, although some made general statements about the presence of a desirable trait without qualifying this further. The disadvantages were often less well discussed, with many referring to cost, ethical concerns or an impact on a food chain without discussing their points in sufficient detail to gain credit.

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.

Candidates should try to match the answers they give with the number of marks available for each part of a question as a three-mark question is most likely to require three separate marking points for example.

Candidates must be familiar with the practical procedures indicated by the syllabus. This includes the common food tests and methods for obtaining valid results.

Candidates should practise drawing accurate representations of biological specimens using appropriate conventions. Lines should be clear and continuous, using a sharp pencil. Candidates should note the appropriate detail of the specimen, including the shape and proportion of the structures.

General comments

Candidates performed well on this paper with some clear and thoughtful answers. Most candidates appeared to perform well in the practical task, producing some excellent results that were clearly presented. Time management also appeared to be good.

Comments on specific questions

Question 1

(a) (i) Many candidates were able to draw a suitable table that accurately represented the data they had collected. The most common error was not including correct units in the heading. Candidates are reminded not to include headings in the body of the table.

(ii) For this question, candidates were asked to calculate the change in distance in millimetres. Some candidates gave this value in centimetres or were unable to convert from centimetres to millimetres accurately.

(iii) Writing a suitable conclusion for this investigation proved challenging. It is important to note that a conclusion is not a description of the results. A small number of candidates correctly concluded that water moved into the dialysis tubing bag that contained sucrose solution.

(b) (i) This question was answered well by many candidates. However, a few candidates simply mentioned the idea of cleaning the bag, which was not accepted.

(ii) The question expected candidates to identify test-tube **W** as a control or to allow comparison. However, a few candidates incorrectly stated that it was a controlled variable.

(iii) Many candidates correctly identified two variables that were kept constant in the investigation. The most common error was being too vague.

- (iv) Many candidates were able to correctly state that the reason for repeating an investigation was to identify anomalous results. Some candidates incorrectly suggested that results were repeated to make them more accurate.
- (v) Candidates found it difficult to describe an alternative method. Any suitable way of measuring the mass or volume of the solution was accepted.

(c) It is clear that candidates have learned the biochemical test for reducing sugars. Most were able to name Benedict's reagent. Some candidates did not state that the mixture needed to be heated.

Question 2

This planning question required candidates to apply their knowledge of transpiration experiments to measure the rate of transpiration in a celery stalk at different temperatures. Most candidates were able to identify the need to test the stalks in at least two different temperatures and most went on to discuss how this could be achieved using a water-bath. However, this was not accepted as it does not change the air temperature. Some candidates correctly identified suitable controlled variables, the most common being the size of the celery stalk and the time left in the dye. When discussing the need to repeat the experiment, it is important that it is repeated at least two more times (i.e. three trials) in the same conditions.

Question 3

- (a) Most candidates correctly measured the insect. Fewer were able to correctly perform the calculation and express their answer to two significant figures.
- (b) (i) This question required candidates to clearly state three differences between the two leaves pictured. Vague answers with no qualification, such as size or shape were not credited. Candidates needed to be clear that the strawberry plant was smaller or that it had three separate leaflets.
 - (ii) Many candidates did not accurately name a suitable indicator that could be used to test for carbon dioxide.
- (c) Candidates drew the banana flower very well indeed. Most candidates were able to draw a suitable outline, although this is still difficult for some. Lines should be clear and continuous, and the diagram should not be shaded. Only a small number of candidates drew a diagram that was smaller than the image. The most challenging part of the drawing for candidates were the details. For the first detail mark, candidates needed to clearly show that in the centre there was a rolled structure. For the second detail mark, they needed to ensure that the bracts at the end were both drawn and overlapped.
- (d) (i) Most candidates were able to access the marks for this question. Candidates were asked to calculate the mass of guava that the person would need to eat to the nearest whole number. Candidates are encouraged to read the question carefully as many did not give their answer to the nearest whole number.
 - (ii) Many candidates completed the graph to a good standard. Most followed the instructions in the question and drew a bar chart. A line graph is used to represent continuous data, and this was discontinuous data. The most common error among candidates was in choosing an appropriate scale. Candidates should be reminded that the chosen scale must allow the data points to take up at least half of the grid. A small number of candidates missed the bar mark as they did not leave even spaces between the bars.
 - (iii) Candidates found it difficult to identify the dependent variable in the investigation, which was the protein content of the fruit. The most common incorrect answer was just the fruit.
- (e) This question required candidates to apply their knowledge to the data to determine the colour after the protein test and starch test had been completed. Colours that are positive or negative results for other food tests could not be accepted, such as blue instead of blue-black, or yellow or orange instead of yellow-brown or orange-brown.

BIOLOGY

Paper 0610/52
Practical Test

Key messages

It is essential that candidates take the 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.

Candidates must 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.

Candidates must be familiar with the practical procedures indicated by the syllabus. This means that candidates are expected to be able to carry out these procedures safely, but also that they should be able to work safely and with competence on practical procedures that derive from learned methods.

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

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

General comments

Overall, candidates performed very well on the paper with some clear and well-constructed answers.

Mathematical skills were excellent throughout the paper and the planning activity was approached with good insight that resulted in some clear and detailed descriptions.

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

Most candidates understood the key points when drawing the specimen, but care should be taken when drawing a neat clear outline and attention should be paid to the details of the specimen.

Comments on specific questions

Question 1

(a) (i) The table of results was generally well constructed and appropriate for the data collected by candidates.

(ii) For a conclusion it is important that candidates go back to the stem of the question and remind themselves of what was being investigated. For this investigation, the conclusion needed to include a reference to light intensity and how it affected the rate of photosynthesis. Some candidates described the effect of distance on the time taken to change colour, without relating this to the aim of the investigation.

(iii) Most candidates were able to identify that the time taken for the colour to change was the dependent variable in this investigation. Reference to just time was acceptable in this case, but ideally time

taken for colour change would have been preferred. In some investigations there are other measurements of time and candidates need to be clear which one they mean.

(iv) Many candidates were able to identify the possible error of determining the actual end-point of the colour change, particularly when the final colour was masked by the green chlorophyll extract. Some candidates referred to the cooling of the water-bath as a possible error in the investigation, but as all of the test-tubes were in the same water-bath, any cooling would have applied equally to every solution. Another common mistake by candidates was to refer to human error, such errors in timing or human reaction time.

(b) Most candidates were able to identify the food tested using DCPIP. Simply stating vitamins did not get the mark.

(c) (i) The drawing was reasonably well done by many, but candidates should concentrate on producing an outline that is clear and neat. A common error was to draw the seed and stalk as broken lines, particularly around the spikes on the seed coat. Some candidates missed marks due to lack of observation of the fine detail of the seed itself.

(ii) The calculation of actual length was done very well but some gave an answer that was to two decimal places rather than two significant figures.

(d) The comparison between the two seeds was well done by the majority of candidates. Although candidates are not expected to know the names of the different structures that make up the seed, many were able to give detailed and clear descriptions of the comparative structures.

(e) (i) When describing the colour change associated with a food test, it is important that colours cannot be confused with other tests. For this reason, the colour of iodine should not be described as yellow or orange as these are possible colours for a positive Benedict's test.

(ii) Most candidates could describe the test for reducing sugars, but several forgot to mention that it needs to be heated, ideally to a temperature of 80 °C.

(f) For the planning question, candidates were asked to determine the effect of weedkiller on the germination of seeds. A few candidates attempted to use the method described in **part 1(a)** with DCPIP, which scored few marks. Generally, the plans were clear and well structured, with good descriptions of the control variables, dependent variable and independent variable. For the dependent variable some candidates did not focus on germination of the seed but measured the growth of the mature plant instead. Safety considerations must be relevant to the investigation, so in this case the relevant safety precaution must relate to the use of weedkiller and possible effects on health.

Question 2

(a) (i) Many candidates found this question particularly demanding. Two issues prevented candidates from scoring a mark. Firstly, several candidates did not place the heat shield between the bulb and the leaf discs, which was required if it were to prevent a temperature rise. Secondly, a significant number of candidates labelled a heat shield that was opaque, such as metal foil or cardboard. This would have prevented light from reaching the leaf discs.

(ii) When describing controlled variables candidates should try to avoid using the term 'amount'. In this case it could mean volume, number or concentration and can be ambiguous. Another common error was for candidates to refer to the leaf discs as 'leaves'. The leaves were used at the start of the investigation but were different from the leaf discs in terms of controlled variables.

(iii) As with the previous question, candidates needed to refer to the concentration of carbon dioxide rather than just the amount.

(b) (i) The graph was drawn well with both axes labelled accurately. The plotting of points was good but the lines joining the points or the line of best fit needs to be done carefully. A line that joins the plotted points needs to be drawn with a ruler. Candidates must consider the scale on the axes before labelling either axis. The plotted points must take up more than half of the available space. That may mean that the axes do not always have to start at zero.

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- (ii) The interpolation and estimation of the sodium hydrogencarbonate concentration from the graph was done very well. Candidates must remember to show on the graph how they made their estimate.
- (iii) The calculation of percentage change in time taken was particularly well done with most candidates scoring both of the marks.

BIOLOGY

Paper 0610/53
Practical Test 53

Key messages

It is essential that candidates take the 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.

Candidates must 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.

Candidates must be familiar with the practical procedures indicated by the syllabus. This means that candidates are expected to be able to carry out these procedures safely, but also that they should be able to work safely and with competence on practical procedures that derive from learned methods.

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

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

General comments

The practical procedure was carried out with some confidence with good results seen in most cases. The table of results and the bar chart were well done, and presentation was generally good. Some candidates would benefit from using a ruler on these questions.

The drawing of a leaf was also well done but attention should be paid to the fine details of the structure, which needs to be shown clearly and neatly.

Mathematical skills across the paper were excellent.

The planning activity was generally well done by those who came up with a novel method and did not try to repeat the method used in **Question 1(a)**.

The analysis of data in **Question 2(b)** produced some very good answers, with some candidates showing an excellent level of understanding of the data.

Comments on specific questions

Question 1

(a) (i) Most candidates were able to identify the colour of the iodine solution when all of the starch had been broken down. A significant number gave the opposite answer and stated the colour when starch was still present. Candidates should try to avoid using words that describe a colour that could be confused with other food tests, for example stating that iodine solution is orange or red, as these are positive results for a Benedict's test for reducing sugars.

(ii) Most candidates constructed suitable tables to record their results and managed to observe a difference in the time taken for the iodine solution to change colour when tea was added as an inhibitor. Some candidates simply recorded the colours observed on the spotting tile rather than the time taken to change colour. It is important that candidates do not put units in the body of the table and only show them in the headings.

(iii) Some candidates did not fully understand the reason for adding tea to the enzyme in this investigation or answered the question in terms of the time taken to change the colour of the iodine solution rather than referring to the action of the enzyme itself. The conclusion should always refer back to the original aim of the investigation.

(iv) Most candidates were able to identify the presence of tea as the independent variable.

(v) This was a demanding question for many candidates. Few understood that the control was to find out if the tea alone could break down starch. Simply stating that it could be used as a comparison was not enough.

(vi) Most candidates were able to identify that the contents of the test-tubes needed to be at the same temperature before they were mixed. If possible, reference should be made to the substances in the test-tubes rather than simply stating that the test-tubes should be at the same temperature.

(vii) There were many very impressive answers to this question with most candidates identifying the difference in the volume of solutions in the test-tubes as an error. Many also suggested a suitable method of overcoming this error.

(viii) Although most candidates were able to identify Benedict's solution as the reagent to test for reducing sugars, some did not include a suitable temperature. Ideally the Benedict's test for reducing sugars should be conducted at a temperature of 80 °C.

(b) The drawing was generally well done. The size was usually adequate, and the serrated edge was observed by most. Candidates need to take care when drawing the outline, and should use smooth, thin continuous lines to represent the structure. The detail marks were often missed. Candidates should observe the structure very carefully before attempting to draw it.

(c) For the planning question, candidates were asked to investigate the optimum temperature at which a biological washing powder cleaned clothes. It is important that candidates do not attempt to use the previous unrelated method in the context of the plan. Those candidates who copied the method of using iodine solution and a spotting tile did not fully answer the question. Otherwise, most candidates gave an excellent description of a method that would get results. Good examples of the controlled variables were given and a range of independent variables was seen. Any safety precautions given should relate to the investigation being carried out, for example wearing gloves to protect against the enzymes in the washing powder. When describing the dependent variable, candidates must make sure that they describe something that can be measured. Some descriptions were too vague, such as 'measure how clean the clothes were' without explaining how this could be quantified.

Question 2

(a) (i) Candidates were able to measure line **AB** accurately and use the equation to calculate the actual width of the villus. A few candidates did not give their answer to two significant figures.

(ii) Although many candidates gave some good comparative differences between the two villi, many did not use descriptions that were clear and unambiguous. It is not expected that candidates should name any of the features of the villi, but a clear description of the areas being compared is essential.

(b) (i) This question asked candidates to plot a bar chart of the data provided. Most did this exceptionally well with many scoring full marks. The bars of a bar chart should not be touching (unlike a histogram) and should be equal in width and spacing. Some candidates did not use a ruler to draw the bars or were inaccurate in the plotting of the bar heights.

(ii) Some candidates did not fully describe the dependent variable and stated just one of the measurements when both intestine length and body length were required.

- (iii) Most candidates were able to calculate the length of the small intestine for the horse, but several forgot to include the unit or gave the wrong unit (cm instead of m).
- (iv) The relationship between diet and the intestine to body length ratio was understood by most candidates but some focused on the animals that were herbivores and carnivores. Few recognised the relationship between omnivores and the other two groups. Some candidates assumed that omnivores would have a ratio mid-way between the other two groups and stated this, despite the numbers clearly showing this not to be true.
- (v) This question was well answered with some very clear and concise answers.
- (vi) It is important that answers are unambiguous and clear. Here for example, some stated that the study should be repeated. This could mean repeat with different animals (a correct answer) or to simply repeat the measurements of length for the same animal (which is incorrect). Other candidates stated that more animals should be tested (1 mark), without saying if the animals should be from the same species or from a broader range of species (2 separate marks).

BIOLOGY

Paper 0610/61
Alternative to Practical

Key messages

Candidates should read questions and instructions carefully. Mistakes were made when candidates did not follow all of the instructions. For example, some did not convert centimetres into millimetres in **Question 1(a)(ii)**.

Candidates should know the difference between significant figures and decimal places. There was some confusion about this in **Question 3(a)**.

When asked to state two variables, for example in **Question 1(b)(iv)**, candidates should write one variable on the first line and the second on the second line. Sometimes candidates gave two variables on the first line, or a list of many variables.

General comments

The standard of responses was often very good with many candidates achieving high marks.

Drawing skills were generally good, although some used a ruler to draw straight lines. Competent graph drawing skills were also demonstrated.

Comments on specific questions

Question 1

(a) (i) Most candidates constructed a table with the correct number of columns. However, some did not clearly identify the independent and dependent variables as their column headings and added time rather than the tube or solution used as the independent variable. While many candidates only put units in the table headings, a significant number also put them in the body of the table. Some candidates repeated words used in column headings in the body of the table. The majority of candidates correctly measured and recorded the distances as instructed.

(ii) Most candidates performed the calculation correctly, although some candidates who measured the distance in centimetres did not then correctly convert their measurement into millimetres as required by the question.

(iii) Candidates found this a demanding question. Some candidates were able to provide a straightforward and accurate statement, many candidates gave an explanation rather than a conclusion. As a result, many candidates provided accounts of osmosis or movement of particles of different sizes through membranes. Others correctly referred to water movement through the membrane but did not specify the direction (into the bag with sucrose solution).

(b) (i) Some candidates stated or described a suitable piece of equipment used to measure volume. However, many candidates did not name a suitable piece of equipment, suggesting items such as a beaker, cup or tube. Weaker responses suggested using a ruler or balance, neither of which was appropriate.

(ii) A number of candidates were able to appreciate that material might be left on the outside of the tubing which could affect the results, and which needed removing before the experiment could proceed. Stronger responses showed an understanding that sucrose moving into the water from

the bag surface might disrupt the concentration gradient and potentially reduce the validity of the experiment. Weaker responses referred to merely cleaning the membrane, or to the removal of dirt or microbes, or that substances adhering to the membrane surface would block the pores.

- (iii) Stronger responses used correct scientific terminology and described test-tube **W** as a control or for comparison. Several candidates gave descriptions that indicated it was essential in order to detect a difference, and these were usually expressed clearly enough to gain credit. A small number wrongly referred to test-tube **W** as a controlled variable.
- (iv) Many candidates correctly stated two constant variables. Some candidates referred to a controlled volume of liquid, but did not go on to specify which liquid they meant, or where it was placed in the experiment. Similarly, some candidates just stated, 'the tubing' and did not specify whether they meant the diameter, size or type of tubing.
- (v) Stronger responses correctly stated that repeating the experiment meant that anomalous results could be identified. However, others incorrectly stated that results were repeated to prevent or avoid anomalous results or errors. Many candidates incorrectly suggested that results were repeated to make them more accurate, or to enable an average to be calculated.
- (vi) Candidates found this a demanding question. It asked for an alternative method of measuring the water movement. Stronger responses correctly suggested specific methods, stating that volume, mass or height should be measured. Several candidates incorrectly interpreted this question as an instruction to suggest extensions to the investigation and so suggested ideas such as using plant tissue, using salt solution, or using a wider range of sucrose concentrations.

(c) Most candidates knew that Benedict's reagent is used to test for reducing sugars. Only some of the candidates went on to state the need to heat the sample with the reagent. A few candidates suggested using a water-bath, but did not specify that it should be at a warm or hot temperature. Weaker responses incorrectly stated the use of Biuret reagent or iodine solution.

Question 2

Most candidates were able to correctly state that several temperatures should be used as the independent variable. Correct references to suitable safety precautions and repetition of the experiment were also common. Most could identify at least one controlled variable. However, many candidates did not appreciate that this investigation was about transpiration. Consequently, they only changed the temperature of the tubes by placing them in water-baths at different temperatures rather than describing a method of changing the air temperature around the celery leaves. Some candidates described what data would be gathered as the dependent variable, both in terms of what might be seen in this experiment and in terms of how this might be measured. Stronger responses gave full descriptions of experimental methods and could describe the process of serial sectioning of a celery stalk to determine dye movement through the xylem.

Question 3

- (a) The majority of candidates were able to do both the measurement and the calculation correctly, but errors were made in the conversion of centimetres to millimetres. Candidates often forgot to round the answer to two significant figures or rounded their answers to two decimal places instead.
- (b) (i) Many candidates were able to identify at least one difference between the specimens given. The three leaflets and the difference in the serration of the leaf edges were the two most commonly mentioned but several also correctly stated that the banana leaf was larger, suggesting a sound understanding of magnification and scale. Weaker responses stated that there were differences but did not give details, for example, 'the shape is different'. Candidates should specify which specimen they are referring to, and exactly what the difference is.
- (ii) There seemed to be a lack of familiarity with limewater as a test solution and a number of candidates suggested incorrect reagents. Another common incorrect answer was photosynthesis, implying that candidates were anticipating exposure of plants to the gas for some time to see if it would allow photosynthesis to proceed.
- (c) Drawings of the biological specimen were often done well, with many drawings of an appropriate size and showing a well-developed appreciation of which details to include in order to provide an accurate record. However, several had poor outlines, with lines from internal structures straying outside the

outline, or gaps in the line. Candidates should be reminded that shading should not be included, and lines should not be ruled.

(d) (i) Many candidates were able to manipulate the figures. Some calculations started well but candidates sometimes rounded too early, leading to an incorrect final answer. Some candidates forgot to multiply by 100, and others did not round their answer to the nearest whole number, while some rounded to the nearest 10.

(ii) Many good examples of bar charts were seen, and many candidates were able to correctly transcribe axis labels from the data table to the chart itself. Scales were usually sensible in terms of the ease of calculation of plots although some scales were too small for the given grid. Most candidates appreciated that a bar chart requires even spacings between bars and a consistent width for the bars. A few candidates drew a line graph.

(iii) The majority of candidates were able to identify protein content as the dependent variable.

(e) This question was demanding for many. A significant number did not complete all the boxes. The question tested both the candidates' knowledge of food tests and their ability to apply this to a given situation. Most who attempted the question realised that for protein, the answer for X and Z should be the same, and for starch the answer for X and Y should be the same. However, their choice of colours was often less sound, and several candidates incorrectly identified the colour expected for a positive starch test as blue rather than blue-black. Similarly, the colour of iodine solution alone was often incorrect with red, orange or yellow chosen as the descriptor instead of yellow-brown.

BIOLOGY

Paper 0610/62
Alternative to Practical

Key messages

Candidates should read questions and instructions carefully. Mistakes were made when candidates did not follow all the instructions. For example, some did not convert the time to seconds in **Question 1(a)(i)**. Some referred to differences in size in **Question 1(d)**, and in **Question 1(e)(i)** some gave the positive result for starch rather than the negative result.

Candidates should know the difference between significant figures and decimal places. There was some confusion about this in **Question 1(c)(ii)**.

Some candidates did not give an answer to **Question 2(a)(i)**, where they had to draw some apparatus on Figure 2.1. Candidates should read all questions carefully to look for instructions and make sure that they do not leave any questions unanswered.

When asked to state two variables, e.g., in **Question 2(a)(ii)**, candidates should list one variable on the first line and the second on the second line. Sometimes candidates gave two variables on the first line, or a list of many variables.

General comments

The standard of responses was often very good with many candidates achieving high marks.

Candidates showed a good understanding of the independent, dependent and constant variables in both investigations outlined in the paper. Candidates should practise recognising errors in investigations and methods for improving an investigation.

Drawing skills were generally good, although some used a ruler to draw straight lines. Competent graph drawing skills were also demonstrated, although candidates are reminded to choose sensible scales for their graphs so that plotting is easier.

There was some confusion between the difference between volume and concentration. Candidates should understand the difference and know the units for both.

Comments on specific questions

Question 1

(a) (i) The majority of candidates drew good tables with columns for test-tube or distance, and time. Most candidates correctly converted the stop-clock times into seconds. The most common mark to miss was marking point two. There were several ways in which this marking point was missed. Some candidates put units into the body of the table or omitted a heading, usually the heading for the test-tubes. Some wrote out 'test-tube' in the body of the table, rather than just 'A' and 'B'. The words 'test-tube' should not be repeated in the column heading and in the body of the table. Additionally, the unit for seconds is 's' and not the abbreviation 'secs'.

(ii) When stating the conclusion for an investigation, candidates should always refer to the statement at the start of the method. In this case, the statement reads: 'Students investigated the effect of light intensity on the rate of photosynthesis in a chloroplast suspension.' Therefore, the conclusion given should relate light intensity to the rate of photosynthesis. In this case, as light intensity increases, the

rate of photosynthesis increases. It is not enough to only refer to the time taken for both test-tubes to return to a green colour, which is a description of the results. Additionally, it is not enough to refer to the rate of reaction being higher at higher light intensities. The conclusion had to link the rate of photosynthesis to light intensity.

(iii) Candidates should practise identifying the dependent and independent variables in investigations. Most were able to state that the dependent variable was time, although some named the independent variable, light intensity, or a constant variable such as volume of DCPIP. Some gave rate of photosynthesis as the dependent variable, but this was not credited as time was recorded rather than rate.

(iv) Step 7 and step 11 in the investigation were to measure the time taken for the blue liquid in the test-tube to return to a green colour. Looking for a colour change can be an error as the end-point can be difficult to determine, as it is subjective and can differ from person to person. Those that recognised this error were likely to also suggest a suitable improvement such as use of a colorimeter or colour chart to compare to. A very common incorrect answer was to suggest there was an error in timing, such as not using the stop-clock correctly. Another common incorrect answer was to say that the investigation was not repeated. Although this is true, it does not relate to the error in step 7 and step 11.

(b) Many candidates were able to name vitamin C (or ascorbic acid) as the substance present in food that can be identified using DCPIP. Those that gave vitamin as their answer did not get the mark. Occasionally, answers such as protein, sugars, or starch were given.

(c) (i) Figure 1.2 showed a photograph of a dandelion seed. Candidates were expected to draw the whole seed, which includes the achene, beak and pappus. Those that just drew the achene were still able to get three marks. Candidates are reminded that drawings should be drawn freehand, in pencil and a ruler should not be used. Some candidates missed a mark for using a ruler to draw the beak of the seed. Drawings were usually bigger than the dandelion photograph but marking point two was sometimes missed for the drawing being so large that it extended into the surrounding text or went off the page. Marking points three and four were for accurately including detail. In this case candidates were expected to draw the beak as a double line, to include the spikes on the achene and to draw the ridge down the achene.

(ii) **PQ** was accurately measured to 19 mm in the majority of cases. Most candidates divided 19 by 15 to calculate the magnification. However, some candidates confused significant figures with decimal places and gave 1.27 as their answer, rather than 1.3. Some rounding errors were seen.

(d) Candidates were not expected to use correct botanical terms to describe one similarity and two differences. However, candidates were told that the photographs were of seeds and not of a seedling or whole plants. Therefore, the pappus should not have been described as being leaves, petals or anthers. Most candidates described both seeds as having a pappus and common differences described included the pappus being thicker in the milk thistle, the presence of the beak in the dandelion and the milk thistle having a smoother or rounder achene. Candidates were given instructions to not use reference to size in their answer. This was because magnification of the photographs was not given. Many candidates ignored this instruction. Therefore, answers such as the dandelion being longer or the achene being thinner did not get a mark.

(e) (i) If a drink that does not contain starch is tested with iodine solution it remains yellow-brown. Most candidates answered this question correctly, although some gave blue-black as the answer, which is the positive result if the solution had contained starch.

(ii) This question was answered well and most candidates named Benedict's solution as the reagent used to test for reducing sugars. The majority also stated that the sample should be heated with the Benedict's solution. Use of a water-bath was not enough for the second mark. Candidates needed to say that a hot water-bath was used. It was not necessary to describe the results of the test as the question just asked for a description of the test for reducing sugars. Occasionally, candidates described the biuret or emulsion test rather than the Benedict's test.

(f) Some very good plans were seen. Candidates often gained full marks by describing the independent and dependent variables, the constant variables and some detail of the method, such as planting the seeds in soil and watering them regularly. Most candidates were able to correctly identify multiple variables that needed to remain constant such as temperature, species of seed, volume of weedkiller,

pH and time the seeds were left for. Candidates should ensure that the plan is clear and straightforward, avoiding the use of the term 'about', for example 'leave the seeds for about 3 days'. Many candidates correctly recognised that the weedkiller solutions could pose a safety issue and gave suitable methods to reduce this risk.

Some candidates confused concentration with volume, so they might have said that the seeds should be exposed to different concentrations of weedkiller, but then described using different volumes rather than different concentrations. Some candidates used different types of weedkiller rather than different concentrations. Also, some were not accurate with their description of the dependent variable. The investigation was to determine the effect of weedkiller concentration on germination of seeds, not on seed growth. So those that measured the length of the seedlings after a certain time rather than the percentage germinated or time taken to germinate, did not get the second marking point. Investigations should be repeated more than once, so those that just said the investigation should be repeated did not get mark point nine.

Question 2

(a) (i) Candidates were expected to draw and label one additional piece of apparatus that could be used to reduce the heating effect of the lamp. Some candidates drew a piece of apparatus but did not label it. Some chose apparatus that would block light from reaching the syringe. This did not gain credit. Use of a labelled heat shield or piece of glass or beaker of water between the syringe and lamp were correct. Some used correct apparatus, such as a water-bath, but only submerged the bottom of the syringe in the water, which would not have had an impact on the heat reaching the syringe. Some drawings were not labelled so did not get the mark.

(ii) Candidates generally were able to state two constant variables in the investigation. Common answers included light intensity, same number or size of leaf discs in the syringe, or same volume of sodium hydrogencarbonate solution. Some gave distance between the syringe and the lamp as one constant variable and light intensity as the second constant variable, but these are the same marking point. Some stated the concentration of sodium hydrogencarbonate solution, but this was the independent variable. Some gave time as their answer, but this was the dependent variable. Some were not precise enough and said the number or size of the leaves was the same in each syringe, rather than leaf discs. Some candidates referred to the same amount of sodium hydrogencarbonate solution.

(iii) The majority of candidates gave carbon dioxide concentration or sodium hydrogencarbonate concentration as the correct answer. Answers such as carbon dioxide unqualified, or amount of carbon dioxide, or concentration of solution were not precise enough for the mark.

(b) (i) Some very good graphs were drawn. Candidates should know that the independent variable is usually placed on the x-axis and the dependent variable on the y-axis. The graphs were often too small if the axes were put the other way round. Candidates should practise planning usable scales such as ten small squares being worth five minutes in this graph, or ten small squares being worth 0.2 percentage concentration of sodium hydrogencarbonate. Those that used scales such as five small squares being worth three minutes often had incorrect plotting. Some candidates did not include a unit for time or gave 'm' rather than minutes or mins as the unit.

If the candidate had drawn a line of best fit close to the plotting points, extrapolation was accepted but only if the line did not extend off the grid. Plot-to-plot lines should not be extrapolated. Lines joined up without a ruler need to be smooth. Only a few bar charts were seen.

(ii) Most candidates followed instructions and indicated on their graph how they obtained an estimate for the sodium hydrogencarbonate concentration at which it took 12 minutes for the leaf discs to float. The best answers showed a line that started at 12 minutes and reached their graph line and then continued to the axis for concentration of sodium hydrogencarbonate solution, showing where their reading was taken from.

(iii) Candidates had to select the correct data from Table 2.1 and use this data to calculate a percentage change. Most correctly selected 20 and 17 from the table, but some did not use this data in a correct percentage change calculation. Others calculated the percentage change between the values 0.2 and 0.4. Candidates should be familiar with percentage change calculations.

BIOLOGY

Paper 0610/63
Alternative to Practical

Key messages

It is essential that candidates take the 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.

Candidates must 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.

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

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

General comments

The table of results and the bar chart were well done, and presentation was generally good. Some candidates would benefit from using a ruler on these questions.

The drawing of a leaf was also well done but attention should be paid to the fine details of the structure, which need to be shown clearly and neatly.

Mathematical skills across the paper were excellent.

The planning activity was generally well done by those who came up with a novel method and did not try to repeat the method used in **Question 1(a)**.

The analysis of data in **Question 2(b)** produced some very good answers, with some candidates showing an excellent level of understanding of the data.

Comments on specific questions

Question 1

(a) (i) Most candidates were able to identify the colour of the iodine solution when all of the starch had been broken down. A significant number gave the opposite answer and stated the colour when starch was still present. Candidates should try to avoid using words that describe a colour that could be confused with other food tests, for example stating that iodine solution is orange or red as these are positive results for a Benedict's test for reducing sugars.

(ii) Most candidates constructed suitable tables to record the results and managed to record the time taken to change colour when tea was added as an inhibitor. Some candidates simply recorded the colours observed on the spotting tile in Figure 1.3 rather than the time taken to change colour. It is important that candidates do not put units in the body of the table and only show them in the headings.

- (iii) Some candidates did not fully understand the reason for adding tea to the enzyme in this investigation or answered the question in terms of the time taken to change the colour of the iodine solution rather than referring to the action of the enzyme itself. The conclusion should always refer back to the original aim of the investigation.
- (iv) Most candidates were able to identify the presence of tea as the independent variable.
- (v) Some good answers were seen but some candidates stated that time was kept constant. This could have meant the sampling time, but it is ambiguous as time to change colour was the dependent variable. Any answers given must be clear and unambiguous.
- (vi) This was a demanding question for many candidates. Few understood that the control was to find out if the tea alone could break down starch. Simply stating that it could be used as a comparison was not enough.
- (vii) Most candidates were able to identify that the contents of the test-tubes needed to be at the same temperature before they were mixed. If possible, reference should be made to the substances in the test-tubes rather than simply stating that the test-tubes should be at the same temperature.
- (viii) There were many very impressive answers to this question with most candidates identifying the difference in the volume of solutions in the test-tubes as an error. Many also suggested a suitable method of overcoming this error.
- (ix) Although most candidates were able to identify Benedict's solution as the reagent to test for reducing sugars, several did not include a suitable temperature. Ideally the Benedict's test for reducing sugars should be conducted at a temperature of 80 °C.

(b) The drawing was generally well done. The size tended to be adequate, and the serrated edge was observed by most. Candidates need to take care when drawing the outline, and should use smooth, thin continuous lines to represent the structure. The detail marks were often missed. Candidates should observe the structure very carefully before attempting to draw it.

(c) For the planning question, candidates were asked to investigate the optimum temperature at which a biological washing powder cleaned clothes. It is important that candidates do not attempt to use the previous unrelated method in the context of the plan. Those candidates who copied the method of using iodine and a spotting tile did not fully answer the question. Otherwise, most candidates gave an excellent description of a method that would get results. Good examples of the controlled variables were given, and a range of independent variables was seen. Any safety precautions given should relate to the investigation being carried out, for example wearing gloves to protect against the enzymes in the washing powder. When describing the dependent variable, candidates must make sure that they describe something that can be measured. Some descriptions were too vague, such as 'measure how clean the clothes were' without explaining how this could be quantified.

Question 2

(a) (i) Candidates were able to measure line **AB** accurately and use the equation to calculate the actual width of the villus. A few candidates did not give an answer to two significant figures.

(ii) Although many candidates gave some good comparative differences between the two villi, many did not use descriptions that were clear and unambiguous. It is not expected that candidates should name any of the features of the villi, but a clear description of the areas being compared is essential.

(b) (i) This question asked candidates to plot a bar chart of the data provided. Most did this exceptionally well with many scoring full marks. The bars of a bar chart should not be touching (unlike a histogram) and should be equal in width and spacing. Some candidates did not use a ruler to draw the bars or were inaccurate in the plotting of the bar heights.

(ii) Some candidates did not fully describe the dependent variable and stated just one of the measurements when both intestine length and body length were required.

(iii) Most candidates were able to calculate the length of the small intestine for the horse, but several forgot to include the unit or gave the wrong unit (cm instead of m).

- (iv) The relationship between diet and the intestine to body length ratio was understood by most candidates but some focused on the animals that were herbivores and carnivores. Few recognised the relationship between omnivores and the other two groups. Some candidates assumed that omnivores would have a ratio mid-way between the other two groups and stated this, despite the numbers clearly showing this not to be true.
- (v) This question was well answered with some very clear and concise answers.
- (vi) It is important that answers are unambiguous and clear. Here for example, some stated that the study should be repeated. This could mean repeat with different animals (a correct answer) or to simply repeat the measurements of length for the same animal (which is incorrect). Other candidates stated that more animals should be tested (1 mark), without saying if the animals should be from the same species or from a broader range of species (2 separate marks).