

BIOLOGY

Paper 0610/12
Multiple Choice (Core)

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

General comments

The exam paper provided breadth and balance, as well as challenge at this level. Some misunderstandings exist about the difference between breathing and respiration; the meaning of 'parallel veins' in plant classification; mechanical barriers to disease, and what effectors are. It was not well known that rice fields release methane gas. There was good knowledge of plant cell structure; levels of organisation; how to test for starch; leaf structure; where haemoglobin is found; the composition of air; reproduction in flowering plants; food webs, and the effects of deforestation. Some candidates found the interpretation of graphs and genetic diagrams challenging.

Comments on specific questions

Question 1

A large number of candidates opted for 'breathing' as a characteristic of living things. This suggests a misconception about the difference between breathing and respiration.

Question 2

While many candidates opted for the correct answer the majority did not know the characteristics of fish.

Question 3

Most candidates answered correctly. There was some uncertainty about the description of leaves being 'parallel-veined' or 'not parallel-veined.'

Questions 4, 5, 8, 9, 10, 12, 14, 16, 23, 32, 34, 36 and 38

These proved to be straightforward questions and were well answered by most candidates.

Question 6

Many candidates derived the correct answer but a minority were unable to do the correct mathematical calculation.

Question 7

Many candidates appreciated that a plant cell in pure water would appear turgid. Some opted for the cell becoming plasmolysed, shrinking and even bursting.

Question 15

Many candidates correctly identified the hairs in the nose as a mechanical barrier to diseases. White blood cell was a common incorrect answer for this question.

Question 17

Many candidates were able to derive the correct answer. Some could not relate the effect of carbon dioxide being removed by soda lime with the overall effect on the volume caused by oxygen being removed by respiration.

Question 18

The majority of candidates correctly identified the liver. The most common incorrect answer was skin.

Question 19

Many candidates appreciated that effectors are muscles. Some opted for receptors or motor neurones, and even the spinal cord.

Question 20

While the majority of candidates selected the correct conclusion some thought that the graph showed that antibiotics are effective against bacterial and viral infections.

Question 22

Although the vast majority of candidates recalled the definition of sexual reproduction, some incorrectly believed that sexual reproduction results in genetically identical offspring.

Question 24

The most common incorrect answer was a time on the graph where the thickness of the uterus wall was increasing.

Question 25

While most candidates realised that monitoring body temperature is a natural method of contraception and the least effective, many selected 'male sterilisation'.

Question 27

This proved to be quite a challenging question with most few selecting the correct option.

Question 28

This was a challenging question with similar numbers of candidates opted for each of the first three options.

Question 31

While most candidates correctly identified energy flow as being linear, starting with sunlight, some believed it to be circular.

Question 39

Few were able to select the correct option for this question.

Question 40

Although many candidates responded correctly, many appeared to be unfamiliar with the stages in the treatment of sewage.

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Paper 0610/22
Multiple Choice (Extended)

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

General comments

While there were some challenging questions, the majority of candidates showed a good understanding of the topics examined. The magnification question was very well done. There was some uncertainty about the advantage of a double circulatory system. Most candidates were not aware that carbon dioxide receptors are located in the brain.

Comments on specific questions

Questions 1, 4, 8, 9, 12, 32, 33 and 39

These questions were well-answered by the majority of candidates.

Question 2

While many candidates selected the correct option some believed that the identical amino acid sequence indicated that the animals were members of the same genus.

Questions 3, 5, 6, 7, 10, 11, 15, 18, 19, 22, 23, 24, 25, 26, 27, 34, 37 and 40

Many candidates were able to select the correct option for these questions.

Question 14

While many candidates opted for the correct answer, some incorrectly believed that an advantage of a double circulatory system was that the blood pressure was kept the same throughout the circulatory system.

Question 16

This proved to be a challenging question with few candidates selecting the correct option.

Question 17

Whilst the majority of candidates were able to derive the correct answer, some were unable to work out how the level of coloured water would be affected.

Question 21

This proved to be a challenging question, requiring careful mathematical analysis.

Question 29

While the majority of candidates understood that heterozygous individuals with the sickle-cell allele are less likely to have malaria, some incorrectly believed that these individuals were more likely to have malaria.

Question 36

While many candidates knew the correct requirement for the production of penicillin in a fermenter, some believed that penicillin production requires anaerobic conditions.

BIOLOGY

Paper 0610/32
Theory (Core)

Key messages

It is vital that candidates read each question with great care.

General comments

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

Comments on specific questions

Question 1

- (a) The uses of insecticides and fertilisers were widely known. Many thought that antibiotics kill viruses or all pathogens. A common error for the use of herbicides was to state that they kill herbs. Few knew that pectinase is used in the production of fruit juice, many assigned it a role in human digestion, probably recognising the –ase ending of the word as indicating that it is an enzyme.

Question 2

- (a) Some candidates correctly identified the capillary. Many stated that it was a vein or an artery, or gave the name of a specific blood vessel, such as the pulmonary artery.
- (b) The majority of candidates could state two differences between red and white blood cells, and many gave three differences. A common misconception was that red blood cells contain no cytoplasm; whereas the usual organelles are absent, the cytoplasm is present and contains the haemoglobin. Some were able to describe the shape of the red blood cells as a biconcave disc but many found the description of shape more challenging.
- (c) (i) The majority knew that plasma was the liquid part of the blood. A few stated water.
- (ii) Most responses gave two or three correct substances. A common error was to give both minerals and ions as different answers. Some incorrectly gave three types of blood cell rather than three substances.

Question 3

This question was answered well by the majority of candidates. The connections least known were that the ribs are involved in breathing and that the cervix is involved in reproduction.

Question 4

- (a) Most candidates selected urea and mineral salts as being two components of urine. A significant number quoted water which was given in the question and therefore not accepted.
- (b) (i) Many gave correct values for the solutions **A** and **C**, but fewer were able to calculate the correct value for **B**.
- (ii) Some candidates could identify solution **C** as the one containing the most sugar and give a reason for their choice. The majority of candidates selected solution **A**.

- (c) Most candidates could state two factors which would affect the volume and concentration of urine.
- (d) Many candidates could state two ways in which the body loses water (apart from in the urine). Some misread the question and gave urine as one of their answers. A common error was to use the term respiration instead of breathing.

Question 5

- (a) (i) Many candidates performed well. Common errors were to identify a chloroplast as the nucleus and the cytoplasm as chlorophyll.
- (ii) On the same diagram, candidates were asked to label the site of the chromosomes and that of the cell membrane. These tasks were carried out competently by the majority.
- (iii) The cell was identified as a palisade mesophyll cell by many candidates. Common incorrect responses were a mesophyll cell or a leaf cell.
- (b) (i) Most responses gave one correct change, usually that the cell or a specific part of the cell had become smaller. Identifying the second difference was more challenging.
- (ii) There were three marks for this question indicating that three differences were required. A few responses gave three differences. Some responses referred to osmosis or the active sites of enzymes. The two most commonly offered differences were the direction of movement and the need for energy in active transport. Overall, this proved to be a challenging question for many.

Question 6

This question was answered competently by many candidates. Nearly all knew that enzymes are biological catalyst, that a suitable temperature is needed and that bacteria are killed by stomach acid. Selection of the final word in the question proved challenging for some as 'fatty acids' was commonly given as the answer, even when all the previous responses had been correct.

Question 7

- (a) (i) Most performed the calculation accurately. As the figures in the table were given to two decimal places, the answers for the water content should also have been given to two decimal places.
- (ii) The majority of candidates answered this accurately.
- (iii) Most gave a correct response to this question. Fibre and vitamins were most commonly cited.
- (iv) The majority of candidates gave a correct response.
- (b) The uses of calcium were very well known and the uses of water were the least well known.
- (c) The health problems associated with a high fat diet were stated accurately by almost all candidates.

Question 8

- (a) The definition of pollination was familiar to most. Some were less sure of the differences between the anther and the stigma. A considerable number had presumably misread the question as they described the difference between wind-pollination and insect-pollination.
- (b) Many responses referred to petal colour, scent and nectaries, none of which are visible on the diagram. Anthers drooping outside the flower structure were commonly mentioned, fewer referred to the characteristics of the stigma.
- (c) Many candidates gave a correct response. Some misinterpreted the magnifications given on the photomicrographs. Some appeared to have misread the question and described how a wind-pollinated flower differed from an insect-pollinated flower.

- (d) The majority of candidates knew that water is needed for germination. The need for oxygen and a suitable temperature were less well known. A common misconception was that light is required for germination.

Question 9

- (a) (i) Offspring **N** and **S** were correctly identified by many candidates. The commonest error was to select **M** and **T**.
- (ii) Many responses provided a good explanation as to why **R** was produced by sexual reproduction.
- (iii) Some candidates recognised the definition of *phenotype*. Many were less secure in the understanding of this term. Common incorrect responses seen were *characteristics* or *dominance*.
- (b) (i) Most candidates could state three characteristics from the illustration that showed continuous variation.
- (ii) Some responses gave a correct example of discontinuous variation.

Question 10

The majority of candidates correctly identified the stages of the water cycle shown in the diagram. The most common error was to refer to the process of transpiration as respiration.

BIOLOGY

<p>Paper 0610/42 Theory (Extended)</p>
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Key messages

A high standard of scientific knowledge and understanding was displayed by many of the candidates. Many candidates should be congratulated for their clear, articulate and accurate responses.

It is important to understand the meaning of command words given in the question paper. There are differences in the responses expected if candidates are asked to 'describe' rather than 'explain'. It is vital that candidates know what is expected of them when responding to questions. The command words of 'describe' and 'explain' in particular, are often misunderstood. 'Describe' generally requires candidates to give an account of the subject in question. 'Explain' requires candidates to set out reasons using their scientific knowledge for the subject in question.

General comments

Some responses only gained some of the marks available as they did not answer the question asked or they lacked sufficient detail. Careful reading of the whole question including the stimulus material is important.

Candidates generally showed good use of language and correct scientific terminology. Many were able to express their ideas in continuous prose. Learning the definitions specified in the syllabus is essential.

Comments on specific questions

Question 1

- (a) (i) It was pleasing to see that all candidates were able to use a dichotomous key correctly.
- (ii) A common incorrect answer was Protocist. Some candidates used the term Monera, whilst this was acceptable, candidates should be reminded to use the terms as outlined in the syllabus. Some were not clear what the term Kingdom meant and gave incorrect responses such as bacteria and microorganisms.
- (b) This question proved more challenging. Some candidates were able to identify a common structure. The question asked for a shared structure rather than a feature, so references to microscopic size were ignored as were absence of a particular structure. Common correct responses referred to the presence of genetic material.
- (c) (i) The question asked candidates to show how the actual length of the bacterium would be calculated. Some responses provided the formula but did not rearrange it to give the correct answer.
- (ii) This question was answered well, with many candidates able to successfully convert values. Common errors included the numerical value being out by a factor of 10 or dividing rather than multiplying by 1000.

- (d) (i) There were many correct descriptions of the effects of cholera bacteria. Fewer were able to explain how cholera bacteria brought about these effects. There were many references to chlorine ions rather than chloride ions. There was also some confusion about the source of the chloride ions with some stating that these were a toxin produced by the cholera bacteria. Good responses referred to the movement of water in terms of water potential. Weaker responses referred to water concentration.
- (ii) Many correct responses were seen including oral rehydration therapy. Drinking more water was an insufficient response unless further qualified by the addition of salts and sugar.

Question 2

- (a) There were some excellent responses to this question, with many candidates providing a detailed comparison of the data and reasonable suggestions for any differences. Some appeared to have misread the key and assumed that COPD would be greater in cities than in villages. Candidates' descriptions of the data proved more successful than suggestions for differences in the data. It was evident there was some confusion between COPD and CHD (coronary heart disease), with surprisingly few citing smoking as a reason for increased rates of COPD.
- (b) (i) There were some instances of responses that repeated the question without adding additional detail. Some confused the hairs in the nose with cilia. Descriptions of the production and role of mucus were much more successful with the majority of candidates gaining at least partial credit. A minority of candidates misread the question and provided a description of inhalation.
- (ii) A common misconception seen was that inhaled air contained only oxygen and exhaled air contained only carbon dioxide. Some candidates chose to include percentages in their responses, which was acceptable.
- (c) (i) Most candidates gave the correct response of intercostal muscles. However, the word was not always spelt correctly; intercoastal was a common way of misspelling of the word. The most common incorrect response seen was diaphragm.
- (ii) Both parts of the question were required to gain the mark. Most candidates were able to describe the differences in pressure and volume accurately.

Question 3

- (a) (i) Most candidates could easily manipulate the data to calculate the correct width.
- (ii) Some candidates found this question more problematic and could not draw a pyramid of biomass. Those that did draw a pyramid of biomass, generally scored highly. It was pleasing to see that very few candidates drew upside down pyramids or bar charts. Some candidates did not gain full credit due to inaccuracies in drawing the width of the bars.
- (b) Most candidates gave the correct term.
- (c) (i) Many candidates identified the correct process and many include a balanced equation. Fewer candidates specified that light energy is transferred to chemical energy. Better responses referred to light energy rather than energy from the Sun. Fewer gave examples of carbohydrate molecules that are used to make biomass. The most common examples seen were starch, proteins and cellulose.
- (ii) Most candidates could identify that energy is lost between the trophic levels. Fewer gave examples of how the energy is lost. The most common reason given for loss of energy was respiration. Only a few related the loss of energy to excretion or the fact that not all of the organism is eaten. A minority did not relate smaller biomass in the fourth trophic level to energy loss. A few responses did not refer to energy loss at all.

- (d) Most candidates were able to explain that biodiversity would be conserved and species may be saved from extinction. Many responses did not give enough benefits for conserving the small area of woodland. A few responses gave the consequences of deforestation or global climate change which did not answer the question.

Question 4

- (a) Most candidates completed the table correctly. The name of the structure had to be linked to the correct letter. The letters C and D and names vagina and cervix were frequently used interchangeably. Occasionally candidates were not specific enough and referred to the uterus as the site of implantation rather than the lining or wall of the uterus.
- (b) Most candidates could state the correct number of chromosomes in human gametes and zygotes.
- (c) Some very good descriptions of the data were seen, with candidates using the axes labels to aid their responses. Some tried to explain the results rather than just provide a description, which was unnecessary. Some responses simply quoted a list of data from the graph which did not provide a complete description.
- (d) (i) Most candidates gave the correct response. A common incorrect response was antibodies.
- (ii) A range of correct STIs were named including HIV and gonorrhoea. Some were unclear of the difference between HIV which is an STI and AIDS which is a group of diseases caused by HIV.
- (iii) Many correct responses were seen. The best responses specified that STIs spread through body fluids. Some gave named examples of body fluids, which was acceptable. 'Fluid' unqualified was not accepted as it lacked sufficient detail. Most were able to state the type contraception used to prevent the spread of STIs. Mechanical or barrier contraception was frequently seen as were the correct examples of condoms or femidoms.

Question 5

- (a) (i) A surprising number of responses only discussed the advantages of farmers using treatment F. Some suggested that the reduction in mean dry mass of weeds would be a disadvantage. In questions such as this where candidates are expected to compare two treatments, statements should be comparative.
- (ii) Some reasonable suggestions were seen such as resistance. Questions with the command word 'suggest' indicate that candidates are expected to apply their knowledge to a new situation rather than to simply recall their knowledge of the topic.
- (iii) This question was challenging for many. It was clear that many were unsure of the action of 2,4-D. Some candidates could identify that this weedkiller would only affect weeds. A common misconception was that this weedkiller caused the crop plants to grow and out compete the weeds. Another misconception was that 2,4-D inhibited the growth of the weeds rather than the reverse.
- (b) The majority of candidates gave the correct response. The most common incorrect response was phototropism.

Question 6

- (a) When asked to define a term, the response should be the definition as quoted in the syllabus. One of the key concepts of chemical digestion is that soluble products are formed. Many candidates stated that smaller molecules were formed without the additional detail of soluble products being formed.
- (b) (i) This question required an explanation rather than a description. It is clear that not all were sure of the difference between the command words 'describe' and 'explain'. Some responses provided good descriptions, which unfortunately did not answer the question. Those that did provide explanations often did not go into enough detail. Only some responses were able to relate the partial breakdown of the protein in the egg white solution to the high pH present in the test-tube. Candidates had more success in their explanations of test-tube 2 and in particular many provided excellent explanations of denaturation in test-tube 3.

- (ii) Many candidates identified test-tube 4 as a control. Fewer could explain the reason for the control in this investigation.
 - (iii) The majority of candidates gave the correct response. Examples of common incorrect structures included the pancreas and the liver.
- (c) Most candidates stated that maltase broke down maltose. Fewer were able to recall the product of maltose being broken down. Various incorrect carbohydrates were seen including fructose, sucrose and galactose. Some responses referred to amylase instead of maltase and gave the site of the enzyme action as the mouth.

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

Key messages

The Practical Test requires candidates to have experience of using a wide range of practical equipment. They should be able to gather valid data and be able to design an experiment that also produces suitable data.

General comments

Successful candidates are able to:

- use a range of practical equipment to gather data that is valid and reliable
- be able to justify their choice of equipment and evaluate its accuracy
- design an experiment that takes into consideration the variables, how the data is going to be collected and how the data will be analysed
- present data in a table, with suitable heading that include the appropriate SI units
- present data graphically with a suitable trend line where appropriate
- label graph axes and include the units
- draw an accurate representation of a biological specimen with clear and continuous lines, using a sharp pencil

Comments on specific questions

Question 1

- (a) (i) It is pleasing to see that most candidates were able to access the full marks for drawing a table. In some cases, candidates omitted suitable heading titles or units for the data collected. A common error was to write the units in the body of the table rather than in the heading.
- (ii) Most candidates were able to complete the calculation correctly. The most common error was to use the number of sections rather than the distance travelled by the stain in the calculation.
- (iii) Most candidates gave a correct response for this question.
- (b) This question was answered well by candidates although, in some instances the variables that they suggested were unqualified, for example 'time' without the qualification of 'time left in the stain'. It is important that candidates understand the difference between a controlled (constant) variable and the independent (changed) or dependent (measured) variables in their experiment. Many gave the independent or dependent variables, rather than providing a suitable controlled variable. The most common correct responses were for the size or type of celery stalk and the size of the sections.
- (c) This was a challenging question for some candidates. Many responses referred to 'accuracy' with no further qualification. It was important that the error was paired with the improvement. The most common correct response was the error of the temperature not remaining constant during the experiment, with use of a water-bath given as the improvement.

- (d) The quality of responses to this question was varied. Many candidates had a very clear idea of how to plan a suitable investigation. There were many excellent, detailed descriptions of the investigation. Most candidates were able to identify at least one controlled variable. The most common error was incorrectly stating how different humidity values would be achieved. Few recognised that the temperature would need to be controlled, but rather associated a change in temperature with a change in humidity.

Question 2

- (a) (i) Good drawings were made with a sharp pencil and showed clear and continuous lines which accurately represented the shape of the structure with the appropriate number of layers. Less successful drawings had jagged lines and shading.
- (ii) Most candidates were able to successfully measure the length of the line. Many were able to correctly calculate the magnification of the bronchus. The most common error was either not rounding to the nearest whole number or providing incorrect units for magnification.
- (b) (i) Almost all candidates were able to correctly calculate the average breathing rate.
- (ii) Similarly, almost all candidates correctly identified the need to repeat the experiment for person 2. General reference to calculating an average was not sufficiently detailed for the marking point.
- (iii) It was very encouraging to see that so many candidates were able to draw a suitable graph. The most common error was not providing suitable units for the axes or drawing incorrect lines of best fit.
- (iv) The majority of candidates were able to estimate the average breathing rate. A common error was not showing on the graph how the answer had been obtained.
- (v) This question was answered well by the majority of candidates. The most common error was not using the data to support the response. It is important to include the units in all data quotations. It was encouraging to see so many candidates provide suitable conclusions based on the data provided.
- (c) (i) Many candidates were able to provide a suitable precaution. Some misinterpreted the question and stated a controlled variable. Others gave responses that would simply not be feasible.
- (ii) This question was answered well by some candidates and some were able to suitably identify two appropriate controlled variables. The most common error was stating the independent and/or dependent variables. The most common error was incorrectly stating that the distance or running time would be controlled.
- (iii) Some candidates were able to correctly state the independent variable.

BIOLOGY

<p>Paper 0610/62 Alternative to Practical</p>

Key messages

- Candidates should be encouraged to read instructions carefully (such as not including labels on a drawing, or how many examples to include in an answer).
- Practical lessons could include identifying aspects of safety that are directly related to the procedure rather than general laboratory practice such as wearing laboratory coats. This will enable candidates to direct their suggested safety precautions to the specific procedures.
- Candidates should be reminded that the practical assessments do not require any reference to theoretical knowledge and they should focus their answers on the practical aspects of the course in this paper.
- Candidates are reminded to always include the appropriate units when stating numeric answers.
- Candidates should use a sharp pencil for graphs and drawings.

General comments

Most candidates seem to be familiar with the practical investigations covered in this examination and had sufficient time to consider all the questions fully. Of the five assessment objectives on experimental skills and investigations, making and recording observations and measurements (**1(a)(ii)**, **2(a)(i)** and **2(a)(ii)**) and interpreting experimental data (**1(a)(iv)**) and **2(b)(v)**) were the two skills achieved by most candidates. Knowledge of the safety precautions (**1(a)(i)**) and **2(c)(i)**) and the evaluation of procedures and improvements (**1(c)**, **2(b)(ii)** and **2(c)(ii)**) were the two skills that many candidates found challenging.

Comments on specific questions

Question 1

The procedures assessed in this question seemed familiar to most candidates and many detailed and well-constructed answers were seen.

- (a) (i)** Many candidates were able to suggest a relevant safety precaution. However, some gave responses relating to operational procedures that would ensure the collection of accurate data rather than the required safety precaution. For example, the careful use of a knife to ensure that all pieces were exactly 5 mm in width was a common incorrect suggestion.
- (ii)** Most candidates were able to construct a table with the correct number of rows and columns to report all the relevant data. Many candidates were also able to determine the total distance travelled by the stain, but the many did not include appropriate units for distance in the column heading only. A relatively small number of candidates gave no units or incorrect units but significant numbers of candidates erroneously included units within the data cells.

- (iii) Most students who had determined the total distance in **2(a)(ii)** correctly, were able to use this information to find the rate of water uptake. However full credit was also achieved by those candidates who were able to show how they used the data in their table correctly, even if the data was incorrect. A common error was to transpose the answers for the warm and cold solutions.
- (iv) Almost all candidates were to suggest a suitable conclusion for this investigation.
- (b) The majority of candidates were able to name two variables that were kept constant in the investigation but more general statements without qualification such as 'time' were not sufficiently detailed. Even though temperature was the independent variable in this investigation, many candidates thought that it was kept constant; this common misconception possibly arose because of the confusion between variables that should remain constant during the testing of each individual sample, rather than variables that were kept constant throughout the entire investigation.
- (c) Candidates found it challenging to identify two sources of error and appropriate improvements for those errors. Many candidates suggested avoidable errors that could have been made by an investigator, such as inaccurate cutting. Examiners expect candidates to focus their attention on the limitations of the procedure outlined in the paper and not on different experiments or errors that should not have occurred if the stated method had been followed. Unfortunately, some stated the lack of repetition as an error, even though this was given as an example in the question.
- (d) Many excellent plans, using a variety of suitable procedures, were seen. Similar numbers of candidates used the information in the initial investigation to devise a technique and correctly described the use of a volumetric or weight potometer. Common misconceptions were to consider that humidity and wind speed were synonymous, or that methods to change temperature would suffice. Very few candidates were able to elaborate on how to change the humidity or gave examples of humidity values that might be used. Many candidates made a brief reference to the use of repeats which lacked sufficient detail for the marking point.

Question 2

Most candidates seemed well prepared for the drawing skills, graphing and magnification calculation questions but fewer candidates were able to gain full credit on questions relating to the variables in this question on the ventilation system.

- (a) (i) Many accurate biological drawings were seen that included sufficient detail. A common error was to make drawings that were either too large, covering the question text, or smaller than the photograph provided. Drawings that were shaded or sketched (broken and overlapping lines) also did not gain full credit. Any labels or additional detail of the surrounding tissues on the drawings were ignored as the question stated that no labels should be included.
- (ii) Many candidates were able to measure the diameter of the bronchus in the photograph precisely. The most common errors were to omit units in the length measurement, and/or to use incorrect units (such as mm or per cent) in the magnification. Many also did not give their magnification answer to the nearest whole number. While many candidates measured the length in centimeters, giving the appropriate units, some of these candidates then divided their length in centimeters by the actual length that was given in millimeters, failing to convert the units of measurement so that both matched. This meant that the magnification they calculated was incorrect.
- (b) (i) Almost all candidates were able to determine the average breathing rate.
- (ii) Some excellent answers to suggest how to determine whether a particular piece of data is anomalous were seen. The most common suggestion was to repeat the test for the person, but a similar number of candidates also correctly suggested that the data could be plotted to check how close the point falls from an expected trend for the other participants. The most commonly noted misconception was a reference to comparison with average data.

- (iii) Many carefully drawn graphs were plotted. Some of the common errors that were seen included:
- unlabelled/mislabelled axes; for example, omitting to state *average* breathing rate or the lack of units
 - scales on axes with unequal divisions
 - extending the line beyond the final point or starting the line before the first point.
- (iv) Many candidates were able to use their graphs to estimate the breathing rate at one minute. A common omission was to not show on the graph how this value was found. Other candidates did not seem to read this instruction, and found a value using a calculation from the graph between the points, rather than reading it off the graph.
- (v) Most candidates were able to give a detailed description of the relationship between running time and breathing rate. Some candidates included an explanation for this trend even though this was not required. Some responses lacked detail of when the graph levelled off, stating 'at some point' rather than quoting a specific value from the data.
- (c) (i) Only those candidates who were familiar with this experimental technique seemed able to give one suitable safety precaution. Many candidates gave precautions that would ensure accurate results rather than resolving safety issues.
- (ii) Many candidates correctly identified two variables that should have been kept constant in this investigation. 'Distance of running' was the most common error.
- (iii) Although many candidates knew that the running time was the variable that was purposefully changed in this investigation, unqualified references to time were not accepted.