BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

The paper produced a good spread of marks, but with most candidates achieving creditable scores.

Comments on specific questions

Question 10

Many candidates found it difficult to relate the large surface area of the intestine to the increased probability of food molecules diffusing into the blood.

Question 11

Nearly all candidates knew the functions of the xylem and phloem, but they could not always recognise these tissues in the photomicrograph.

Question 13

There was some confusion between the hepatic vein and the hepatic portal vein.

Question 14

Candidates needed to realise that, since blood always flows down a pressure gradient, the pressure in the veins must be lower than that in the capillaries.

Question 15

Most candidates were able to work out which way the blood flows through the valve in the vein. However, a significant number thought that the pulmonary vein carries blood from the heart to the lungs.

Question 19

With careful examination of this diagram of the kidney machine, candidates should have been able to identify urea as the substance not initially present in the dialysis fluid, but appearing in the fluid later.

Question 21

Many candidates did not appreciate that the receptor for the pupil reflex is in the retina.

Question 28

This question required candidates to evaluate data, which proved challenging for many.

Question 35

A common misconception was the belief that the human zygote does not begin to divide until it reaches the uterus.

Question 39

Many candidates' understanding of natural selection was incomplete which meant that they found this question challenging.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General comments

The paper produced a good spread of marks, but with most candidates achieving creditable scores.

Comments on specific questions

Question 12

Many candidates confused diffusion (through the stoma) with evaporation (from the surface of the mesophyll).

Question 14

Candidates needed to understand that, since blood always flows down a pressure gradient, the pressure in the veins must be lower than that in the capillaries.

Question 15

Most candidates were able to work out which way the blood flows through the valve in the vein. However, a significant number thought that the pulmonary vein carries blood from the heart to the lungs.

Question 25

Many candidates believed that heroin is a stimulant.

Question 27

This question required candidates to apply their knowledge of the structure of fungi to a specific situation. Many found this challenging.

Question 28

The question required data evaluation, which many candidates found challenging.

Question 29

In the pyramid of numbers, most candidates understood that the population of lice would be larger than that of the owls. Fewer candidates realised that there would be more plants than insects.

Question 30

This was a challenging question. It required candidates to relate their knowledge of the carbon cycle to their understanding of food chains.

Question 31

Many candidates did not know that releasing infertile male mosquitoes is an effective way of controlling the malarial vector.

Question 32

The concept of biodiversity was generally not well understood.

Question 38

Candidates often did not appreciate the role of the environment in determining the size of a person's feet.

Question 40

Genetic engineering is a challenging concept for many candidates.

BIOLOGY

Paper 5090/21
Theory

Key messages

Several candidates strayed from the question and, instead of restricting themselves to specific points, gave more general accounts of related issues. It is good practice to re-read the question while answering it to ensure that the points being made are relevant to what the question is asking.

General comments

Some very impressive work was seen, and even those who found the paper challenging were able to display some knowledge on almost all the questions. All candidates appeared to manage their time competently, with no evidence of problems over completing the paper in the time available.

Comments on specific questions

Section A

Question 1

(a) (i) Some candidates thought that there was only one consumer (presumably the kingfisher) and also that there was only one food chain.

(ii) This question posed some problems to a significant number of candidates. Inverted pyramids were quite common – either with, or without inverted labelling. So, too, were pyramids of numbers with guesses made at the relevant comparable numbers at each trophic level.

(b) (i) The majority of candidates described eutrophication followed by decomposition and the effects of these processes on the food supplies for the beetles and frogs. Many suggested that algal bloom would prevent the entry of light into the pond, and also a resultant lack of oxygen, forgetting that photosynthesising algae would produce an abundance of oxygen.

Question 2

(a) (i) This was almost universally answered correctly.

(ii) This was usually correctly answered, but it was difficult to know whether those who labelled the epididymis were mistaken, or careless with their labelling. The prostate was the most common incorrect answer.

(iii) Perhaps surprisingly, many thought that this question concerned the shape of the head of the sperm rather than being about the nucleus within it. Thus, many answers referred to the pointed head not found in other cells. A significant number gave answers that related to the inheritance of sex rather than the fact that the sperm is haploid, so as to produce a diploid zygote at fertilisation.

(b) For some, ‘size’ was mistakenly taken to mean ‘shape’, but usually answers were correct.

(c) This was usually correctly answered but, occasionally ‘embryo’ replaced ‘fertilisation’.

Question 3

(a) The diagram clearly shows a fruit, and the question specifically asks about its likely wind-dispersal, but still a large number of candidates imagined it was a flower, and spoke of wind-pollination, describing the structures as stigmas, styles or stamens. The fact that it might be light in weight could not be deduced from the diagram.

(b) (i) Some referred to the scattering of the points on the graph, thus missing the general pattern that the plotted points display.

(ii) This was almost universally correctly answered.

(iii) This question discriminated well. For the more able candidates, it was an opportunity to display their accurate and detailed knowledge. Those who believed that the process was associated with pollination struggled to make any relevant points.

(c) This was usually well-answered, but there was a significant number of candidates who believed that light or fertile soil affects germination. Reference to light was then qualified with an explanation of its requirement for photosynthesis – perhaps another case of not having carefully read the question.

Question 4

(a) Although this was usually correctly answered, several candidates displayed confusion by reversing the correct answer, thus believing that the left-hand side of the heart sends blood to the lungs, and the right-hand side sends blood to the rest of the body tissues.

(b) (i) It might be expected that those who were successful with **(a)** above would probably score well on this part. However, this was not always the case. The most unlikely combinations of letters were offered, with sometimes 4 letters in one box and 2 in the other. It would appear that the function of the heart is not clearly understood by as many candidates as might have been expected.

(ii) This was almost always correctly answered, but just occasionally the reverse of the correct answer was given.

(iii) The thicker walls of the left ventricle were often mentioned, but reference to muscles was less frequent. Several of the weaker answers referred to the thickness of the walls being necessary to 'withstand' the pressure in the heart.

Question 5

(a) (i) Some answers were accurate and thorough, but several candidates were clearly describing a bacterium and those gave a list of characteristics that were, in the main, the reverse of what was required, (e.g. the presence of cytoplasm, cell membrane and nucleus).

(ii) Many correctly described the effect of HIV on the immune system. However, few referred to the destruction of white blood cells thus affecting phagocytosis and the production of antibodies. Several candidates revealed a basic misunderstanding by stating that it is the virus that becomes immune.

(b) (i) Although usually correctly answered, there was the worrying suggestion from several candidates that any type of contraception would help – spermicides in particular being mentioned.

(ii) The sharing of needles/sharps, blood transfusions and mother to baby were commonly mentioned as means of transmission.

Section B

Question 6

Often, candidates' answers related more, if not entirely, to photosynthesis than to transpiration. However, that did not prevent them from scoring some marks for the correct identification of structures.

The most common error was then to identify the cuticle as the epidermis. Most forgot to refer to it as waterproof, and some suggested that it was for 'controlling' transpiration.

The xylem was usually identified correctly, apart from the expected few who thought it was the phloem. The functions of xylem were well known.

The importance of the air spaces in the spongy mesophyll was not often linked to diffusion, and there were extremely few references to the walls of the spongy mesophyll cells being coated with a water film.

The functions of stomata were well-understood, but very few referred to the diffusion of water vapour through them.

Question 7

(a) This was a relatively easy two marks for those candidates who had learnt their definition of an allele – which was a high percentage of them, though some erroneously suggested that alleles are found within a gene.

(b) This was straightforward for those who are comfortable with genetics. Full marks were common, though the most frequent error was to place two letters in each of the circles representing the gametes. Several candidates, however, did not treat the question as a standard genetic diagram, and included numbers rather than letters in their answers.

Section C

Question 8

(a) Most candidates managed to name a stimulus and a corresponding response. Several, however, failed to refer to a receptor and even more to the importance of the response. The question asks for a description of one example, thus a reference to 'protection' alone was not considered to be sufficient to gain credit for its importance.

(b) This was very well answered with all points regularly being mentioned. 'Message' rather than the required word 'impulse' was quite common and, occasionally, sensory and motor neurones were reversed.

Question 9

(a) Candidates found it difficult to express their answers to this question but, even so, the more able showed a sound grasp of the principles of negative feedback. It was uncommon for candidates to mention that a change in a parameter has to be detected and a description of the appropriate response was rare. However, most candidates were able to include sufficient factual material to score well.

(b) Nerve endings were never mentioned and, with reference to hair, the trapping of less air and thus the loss of insulation was overlooked. However, full marks to the question were still available without these references, and generally scores were high. The most common was the suggestion that capillaries are capable of rising up towards the surface of the skin.

BIOLOGY

Paper 5090/22
Theory

Key messages

A number of candidates appear, as in previous sessions, to have read particular questions only sufficiently thoroughly to ascertain the topic being examined; going on to give a general account of it rather than to restrict their response to the specific aspect of that topic as required by the question. As a result, marks were lost. Centres are reminded that candidates should be guided in the length of each of their responses by the number of lines provided and by the number of marks available. A number of questions required the candidate to study carefully and to understand clearly a significant amount of information provided by the question. It was felt by Examiners that a proportion of candidates may not have allocated sufficient time to this task prior to responding.

General comments

Some very competent work was seen from the more highly attaining candidates. The structure of components of the leaf and their importance in photosynthesis in **Question 6** was well known by many candidates. The causes of Down's syndrome and of sickle cell anaemia in **Question 7** were often less well understood. Questions requiring application of knowledge to a previously unseen context continued to provide more challenge for even the more highly attaining candidates.

SECTION A

Question 1

(a) This was generally well answered. For structures **A** and **B** confusion between which were 'sepals' and which were 'petals' was the most common error, together with reference to 'support' rather than to 'protection' for the function of structure **A**. The identity and function of structure **C** was most often correctly deduced. Structure **D** was commonly incorrectly identified as the 'stigma' with a consequent incorrectly deduced function. A minority of candidates incorrectly identified structures **C** and **D** to be 'xylem' and 'phloem' respectively.

(b) (i) This was well answered by the majority of candidates. Common errors included structures drawn in the centre of the section, labelling 'xylem' and 'phloem' in the reverse locations, and root structure being shown instead of stem structure.

(ii) This was very well answered, with reference to 'water' being more common than to 'minerals'. The most common error was reference to 'absorption' rather than to 'transport'.

Question 2

(a) (i)(ii) These parts were generally well answered, with a common error in **(i)** being reference to 'artery' with no associated name. In part **(ii)** Examiners ignored reference to associated terms such as 'heart attack' and 'atheroma'. This enabled a larger number of candidates to gain credit for reference to a correct term in addition to an associated term.

(iii) A significant number of candidates made insubstantial reference to a 'high level of fat' or to the 'deposition of fat' rather than to the specific factor relating to fat in the **diet**.

(iv) Many candidates did not make reference to a reduction in the rate of aerobic respiration or to the production of lactic acid resulting from the process of anaerobic respiration. Centres are advised to

teach candidates to make reference to a **named** type of respiration in their responses rather than to 'respiration' alone.

(b) Many candidates did not appear to appreciate that the balloon opened the metal mesh and that the mesh then pushed on the blockage, causing the lumen of the blood vessel to widen. Many candidates suggested that the metal mesh would break up or push away the substance blocking the vessel, rather than push it against the wall as shown in the diagram. Reference to maintenance of a wider diameter by the mesh was only sometimes deduced by candidates. Many candidates incorrectly referred to enabling an increased blood flow when suggesting the purpose of inflating the balloon. Blood would not flow at all during inflation of the balloon; rather blood flow would increase only **after removal** of the balloon, leaving the hollow metal mesh in the blood vessel. The first diagram in **Question 2** indicates that the blood vessel is narrowed rather than completely blocked. It was therefore an **increase** in blood flow following treatment that Examiners were looking for in candidates' responses.

Question 3

(a) (i) This was generally well answered. A significant proportion of candidates did not make reference to either the constant thickness of lens at the object's furthest distance from the eye, or to a data value to describe the point at which this constant thickness of the lens is reached. When data values were quoted, Examiners were looking for both a value **and** the correct unit to award credit. Centres are reminded to inform candidates to always include the correct unit for any data value where appropriate.

(ii) This was generally well answered, with the majority of candidates able to correctly identify the components of the eye resulting in the change. Many were able to go on to correctly describe the action of these named components. A proportion of candidates unnecessarily provided detail of both close and distant vision, rather than restricting their response to that required by the question. Reference to the action of the ciliary 'muscles' rather than to the ciliary 'body' was required to gain full credit. One common error was to reverse the action of correctly named components responsible for close and distance vision. Another was to name and describe the function of structures responsible for the candidate reflex in response to changing light intensity.

(b) Candidates who correctly identified the 'convex' lens as suitable often went on to give a good explanation for this. Reference to 'light' alone instead of to 'light rays' was common and was not awarded credit. Candidates' use of terminology relating to the effect on the light rays was often inconsistent. Examiners were looking for reference to 'refraction' by the artificial lens; followed by further 'refraction' by the eye lens; leading to 'convergence' on the retina; resulting in a 'focused' image. Candidates who incorrectly identified the 'concave' lens as suitable rarely gave a sufficiently detailed response to gain the one mark available in that circumstance.

Question 4

Candidates were required to study carefully and to understand clearly the information provided by the question prior to responding. For candidates who did so this was a question in which more significant credit was gained.

(a) (i) This was generally well answered with the majority of candidates being able to identify the key patterns in the data. It was less common for candidates to appreciate that without fertiliser a crop yield of 200 kg/hectare was still produced. A number of candidates read figures incorrectly from the scale of the graph. Centres are advised to encourage candidates to draw construction lines on graphs to assist with accuracy when reading data from them. As in **Question 3**, candidates were required to quote data values in order to gain full credit. Whilst Examiners did **not** insist on the presence of a correct unit for any data value on this occasion, it is important that candidates are instructed as good practice to always include the correct unit for any data value where appropriate.

(ii) This was well answered by candidates who wrote in sufficient detail to fully describe the processes involved in this sequence. Reference to absorption by the 'root' rather than by the 'root hair' was common and did not gain credit. The majority of candidates made correct reference to the uptake of nitrates by either 'active transport' or 'diffusion'. Some went on to make incorrect additional reference to 'osmosis', in which case credit for the correct terms was not awarded. Correct reference to the production of 'amino acids' and/or 'protein' was common. Less common was

reference to the resulting **increased** growth of the plant. The most common incorrect response was to describe aspects of the nitrogen cycle which were not relevant to the question asked.

(iii) This was moderately well answered, with the best responses showing an appreciation of both the negative economic and biological impacts of using a higher mass of fertiliser. Many candidates made correct reference to the possible entry of fertilisers into rivers and streams and the consequence of this in terms of eutrophication and a **negative** effect on aquatic life. Centres are reminded that responses that refer in neutral terms to an 'effect', without reference to the specific nature of the effect, are unlikely to gain credit.

(b) The majority of candidates correctly named 'magnesium' as the type of mineral ion. Most of these candidates went on to correctly state the importance of this mineral ion with reference to 'chlorophyll'. A significant number made reference only to 'chloroplasts', whilst others made reference to described symptoms of chlorophyll deficiency; neither of which were sufficient to gain credit. A small number of candidates named a correct ion other than magnesium but were, almost without exception, unable then to state a correctly linked function for the ion named.

Question 5

This was well answered. Candidates worked hard to use their knowledge and understanding to solve the problem posed by the question. There was confusion by a minority of candidates between the processes of 'ingestion' and 'egestion'. The most common incorrect response was the omission of either region **P** or region **R** with reference to the secretion of amylase.

SECTION B

Question 6

This was well answered by the majority of candidates, with a high number of candidates gaining full credit. Responses were generally well written and points well sequenced.

The less well known part was **U**, where reference to either 'vascular bundle' alone or to 'xylem' in addition to 'phloem' was common and did not gain credit. Correct reference to the substance transported by **U** as 'sucrose' and/or 'amino acids' gained credit; with the most common incorrect reference being to the transport of 'glucose'. References in **U** to **both** 'source' **and** 'sink', or to **two** named locations within the plant, were not commonly seen.

In part **W** many candidates did not gain credit for a correct reference to 'transpiration' as they did not then link this to its role in the supply of water for the process of photosynthesis. Many candidates instead made reference **only** to loss of water vapour which did not gain credit.

Candidates were assisted by the mark scheme containing correct points that may gain credit in more than one part of the question. For example reference to 'chloroplasts' or 'chlorophyll' and the 'absorption of light' could gain credit in **both** part **T and** part **V**.

Question 7

(a) A proportion of candidates were able to provide a correct and clearly expressed response here. There was however a lack of precision from many regarding scientific accuracy. There was also confusion amongst many regarding correct use of terminology. In the case of Down's syndrome, incorrect reference to 'genes' or 'alleles' instead of to 'chromosomes' was common. Also common was incorrect reference to an additional **pair** of chromosomes being present rather than to an additional chromosome. The number of chromosomes in a human cell was sometimes incorrectly stated. In the case of sickle cell anaemia, detail of the effect on red blood cells and the carriage of oxygen was common and did not gain credit. Less common was correct reference to 'gene mutation' and to the requirement for two copies of the recessive allele to be present for the condition to be expressed.

(b) (i) This was generally well answered. A common error was the inclusion of two alleles in each gamete. Where candidates understood less well the meaning of terms such as 'genotype' and 'gamete', credit was more limited.

(ii) This was well answered, with responses being accepted in a variety of formats. Occasionally candidates gave an incorrect conversion into decimal or ratio format from a correctly stated fraction. Such responses did not gain credit. The **only** probability accepted by Examiners for the 'same blood group' was that calculated from a correctly derived genetics diagram in **(b)(i)**.

(iii) This was well answered, with the most common incorrect responses being 'incomplete dominance' or 'monohybrid'.

SECTION C

Each question was answered by an approximately equal number of candidates.

Candidates answering **Question 8** commonly gained more credit than those answering **Question 9**.

Question 8

(a) This was well answered in both parts by the majority of candidates. Few candidates made reference to 'enzymes' but all other marking points were frequently seen. Responses were typically well sequenced and biologically accurate.

(b) This was less well answered by some candidates than **(a)**. Examiners were surprised to see few references to 'genetic engineering' or 'genetic modification'. Incorrect reference to the insertion of 'insulin' rather than of the 'insulin gene' was common, as was incorrect reference to insertion into the 'bacteria' rather than into the 'bacterial DNA'. Use of a 'fermenter' and of 'bacteria' were both well known, as was the importance for the bacteria to 'reproduce'. Centres are advised that this area of the syllabus provides a good opportunity to revise the features of bacteria; most notably containing **no** nucleus being important here.

Question 9

Responses here were typically less well sequenced than those in **Question 8** and did not always fully address the questions asked.

(a) Many candidates responded in terms of the importance to the body or to the specific enzymes required to digest particular nutrient groups. Instead the question required an explanation in more general terms of why most foods eaten must be digested. Correct reference to 'molecules' was not commonly seen, with candidates instead often referring to either 'particles' or 'substances'; neither of which was sufficiently specific to gain credit.

(b) For the liver the production of 'bile' was most commonly known, with some candidates able to go on to correctly describe the importance of bile in terms of increasing surface area and to detail the subsequent action of lipase enzyme. Instead of answering the question asked, many candidates provided detailed descriptions of glucose/glycogen metabolism, deamination and detoxification which did not gain credit. For the pancreas, reference to the production of 'enzymes', which were also commonly correctly named, enabled many candidates to gain credit. It was common though for the substrates and/or products of these enzymes to be incorrectly named. Many responses did not answer the question asked and focused instead on insulin and/or glucagon production and the respective roles of these in metabolism.

BIOLOGY

Paper 5090/31
Practical Test

Key messages

Candidates should read questions carefully, ensure that they follow instructions and answer the questions fully and as set.

As stated on the front cover of the exam paper, candidates should show all working when asked.

Sharp pencils should be used for drawings and graphs.

Candidates should be familiar with the names and usage of standard laboratory equipment.

Candidates should appreciate the differences between reliability, validity and accuracy in investigations.

The difference between length and width should be understood.

General comments

Candidates seemed to have adequate time to complete the paper.

Almost all scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written.

Graph and answers involving calculations were generally well-answered.

Scientific terms such as ‘mass’ or ‘volume’ are becoming more widely and correctly used rather than general terms such as ‘amount’.

Comments on specific questions

Question 1

(a) (i) The vast majority of candidates correctly recorded six temperatures decreasing with time, in each column of the table provided. As no heat was applied to the test-tubes during this investigation, candidates who recorded an increase in temperature at some point should have realised that an error in reading the thermometer had been made. A few candidates incorrectly recorded temperatures as e.g. 6.6 instead of 66.

(ii) An investigation is reliable if it can be repeated with similar results. A mean/average result obtained from several repeats of the same investigation is more reliable than the results of carrying it out once. So, repeating the same investigation and calculating the mean/average result can improve reliability. A good number of candidates correctly stated this in their answers. Answers that could not be credited related to improving accuracy or validity rather than reliability. Other answers that could not be credited involved changing the method of the investigation so that it was not the same investigation that was being repeated.

(b) (i) Many well-constructed graphs scored full marks for this question.

Such graphs were correctly orientated with the independent variable (time) on the x-axis and the dependent variable (temperature) on the y-axis. Both axes were fully labelled with the value and

correct unit. A few candidates incorrectly labelled time in seconds – not having read the information given or the table header sufficiently carefully.

In the best graphs, suitable linear scales were used on both axes, with a value given at the origin of both. To make good use of the grid many candidates did well to choose to start the y-axis scale at a value higher than 0, or, if starting at 0, inserted a scale break to show that the initial part of the scale was not linear.

The majority of candidates plotted the points clearly and accurately. Care should be taken when choosing a scale. A few used scales (e.g. 2 mm representing 1.5 °C) that may have made good use of the grid but made plotting accurately difficult.

The vast majority of candidates understood the instruction to construct two lines on one set of axes and labelled the two lines or made a key to identify them. Some omitted labels or a key. A few erroneously divided the grid into two halves, constructed two sets of axes and plotted one line on each.

Although instructed to join their points with ruled, straight lines, some candidates hand-drew lines or drew a ruled line of best fit which did not join the points.

Although there was an instruction to construct a graph, a few bar charts were drawn in error.

(ii) Many candidates followed the instructions and calculated the correct temperature of the water in the large test-tube at 3 minutes in °C, indicating with a line on their graph how they had worked this out. Frequently, however, marks could not be awarded because no working was shown, or because the temperature of the water in the small test-tube had been calculated, or because no units were given with the temperature value.

(iii) There were many creditworthy conclusions either in terms of animal size or of test-tube size i.e. heat loss was greater or faster in the small test-tube. A few candidates correctly answered in terms of surface area to volume ratio i.e. the smaller surface area to volume ratio test-tube or animal lost less heat.

(c) (i) A good number of candidates applied the conclusion from the investigation to correctly suggest that penguins in the colder climate of the South Pole are larger than those found in the warmer climate of New Zealand. The best explanations related the larger size to a lower surface area to volume ratio than in the smaller penguins and hence a decrease in heat loss. It was important to recognise that the investigation was about surface area to volume ratio and not simply surface area as a few candidates stated.

(ii) This was generally less well-answered as larger animals with lower surface area to volume ratio lose less heat than smaller ones. Small penguins huddled together to form a larger 'body' decrease their total surface area to volume ratio, resulting in reducing heat loss to the very cold environment. Information about how that heat was lost in terms of conduction, convection or radiation was not relevant to this question.

Question 2

(a) There were some excellent drawings, with clear continuous outlines drawn with a sharp pencil. Some were not much larger than the tooth in the photograph although a large drawing had been asked for. It should have been observed that the upper surface of the crown of the tooth was almost level with a central indentation, and that there was a curvature to the right at the base of the left-hand root.

(b) (i) 'Length' and 'width' for some candidates were interchangeable words. This led to lines being drawn horizontally from side to side across the tooth (width) instead of vertically from top to bottom of the tooth (length). Lines that were drawn diagonally could not be credited, neither could those drawn vertically but not at the point of maximum length or those that extended beyond the maximum length.

The vast majority of candidates measured accurately and recorded their measurements with correct units. There were a few candidates who mis-read rulers e.g. 33 mm instead of 38 mm, and even fewer who did not know how to read a ruler e.g. 30.8 instead of 38.

(ii) Many candidates correctly calculated the magnification by dividing their drawing measurement by the photograph measurement. Care should be taken in rounding decimal places. A few candidates included units with their magnification answer which meant that it could not be credited.

(c) (i) A number of candidates focused only on the safety aspect of this answer without describing a method that could be used to measure the pH of the plaque. The principal safety aspect should be that plaque should not be tested in situ but should be removed from the teeth before testing with Universal Indicator or a pH meter. The pH could then be determined by reference to a colour chart or reading the meter.

(ii) This proved a challenging question for many candidates. Good answers recognised that the regular lowering in pH took place at times after food had been consumed. Bacteria in plaque used food left on the teeth, especially sugars, in anaerobic respiration as a result of which lactic acid was produced which lowered the pH. Also the eating of acidic foods could lower the pH.

Common errors included that higher pH values are acidic, that plaque is the same as dental decay, or that saliva has a pH below 6.

(iii) This was another challenging question. However, there were candidates who, in comparing the graph of candidate Q with that of candidate P, identified that Q had no regular pattern of meals but was taking in food irregularly through the day which the bacteria in the plaque acted on. Hence the pH of Q's plaque was below 5.5 more frequently than P's, with such longer exposure to acidic conditions causing damage to the tooth enamel leading to dental decay.

(d) The vast majority of candidates realised that mouthwash had to be used in this investigation but there were a few who failed to mention this.

A number of candidates rightly recognised that such an investigation would need to be controlled and used a group of candidates who did not use mouthwash, or used water instead, to compare with the experimental group who did. Ideally, these two groups were of equal size.

The best answers made the use of the same mouthwash or no mouthwash the only variable in the investigation, stating that all the candidates should eat the same food and have the pH of their tooth plaque measured after eating this food as well as after using the mouthwash or not. There were candidates who mentioned measuring pH but failed to state that it was of the plaque – it could have been, for example, of the mouthwash so could not be credited.

More candidates correctly used 'volume' rather than 'amount' when referring to the mouthwash used. Better candidates mentioned other factors that should have been kept constant for both groups e.g. the length of time for which mouthwash or water was used, or the time interval between eating and pH testing.

A small minority of candidates wrote about the possible benefits of using mouthwash instead of designing an investigation to determine whether its use is beneficial. Such answers could not be credited.

BIOLOGY

Paper 5090/32
Practical Test

Key messages

Candidates should read questions carefully, ensure that they follow instructions and answer the questions fully and as set.

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Candidates should be familiar with the names and usage of standard laboratory equipment.

Candidates should appreciate the differences between reliability, validity and accuracy in investigations.

The difference between length and width should be understood.

General comments

Candidates seemed to have adequate time to complete the paper.

Almost all scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written.

Graph and answers involving calculations were generally well-answered.

Scientific terms such as ‘mass’ or ‘volume’ are becoming more widely and correctly used rather than general terms such as ‘amount’.

Comments on specific questions

Question 1

(a) (i) The vast majority of candidates correctly recorded six temperatures decreasing with time, in each column of the table provided. As no heat was applied to the test-tubes during this investigation, candidates who recorded an increase in temperature at some point should have realised that an error in reading the thermometer had been made. A few candidates incorrectly recorded temperatures as e.g. 6.6 instead of 66.

(ii) An investigation is reliable if it can be repeated with similar results. A mean/average result obtained from several repeats of the same investigation is more reliable than the results of carrying it out once. So, repeating the same investigation and calculating the mean/average result can improve reliability. A good number of candidates correctly stated this in their answers. Answers that could not be credited related to improving accuracy or validity rather than reliability. Other answers that could not be credited involved changing the method of the investigation so that it was not the same investigation that was being repeated.

(b) (i) Many well-constructed graphs scored full marks for this question.

Such graphs were correctly orientated with the independent variable (time) on the x-axis and the dependent variable (temperature) on the y-axis. Both axes were fully labelled with the value and

correct unit. A few candidates incorrectly labelled time in seconds – not having read the information given or the table header sufficiently carefully.

In the best graphs, suitable linear scales were used on both axes, with a value given at the origin of both. To make good use of the grid many candidates did well to choose to start the y-axis scale at a value higher than 0, or, if starting at 0, inserted a scale break to show that the initial part of the scale was not linear.

The majority of candidates plotted the points clearly and accurately. Care should be taken when choosing a scale. A few used scales (e.g. 2 mm representing 1.5 °C) that may have made good use of the grid but made plotting accurately difficult.

The vast majority of candidates understood the instruction to construct two lines on one set of axes and labelled the two lines or made a key to identify them. Some omitted labels or a key. A few erroneously divided the grid into two halves, constructed two sets of axes and plotted one line on each.

Although instructed to join their points with ruled, straight lines, some candidates hand-drew lines or drew a ruled line of best fit which did not join the points.

Although there was an instruction to construct a graph, a few bar charts were drawn in error.

(ii) Many candidates followed the instructions and calculated the correct temperature of the water in the large test-tube at 3 minutes in °C, indicating with a line on their graph how they had worked this out. Frequently, however, marks could not be awarded because no working was shown, or because the temperature of the water in the small test-tube had been calculated, or because no units were given with the temperature value.

(iii) There were many creditworthy conclusions either in terms of animal size or of test-tube size i.e. heat loss was greater or faster in the small test-tube. A few candidates correctly answered in terms of surface area to volume ratio i.e. the smaller surface area to volume ratio test-tube or animal lost less heat.

(c) (i) A good number of candidates applied the conclusion from the investigation to correctly suggest that penguins in the colder climate of the South Pole are larger than those found in the warmer climate of New Zealand. The best explanations related the larger size to a lower surface area to volume ratio than in the smaller penguins and hence a decrease in heat loss. It was important to recognise that the investigation was about surface area to volume ratio and not simply surface area as a few candidates stated.

(ii) This was generally less well-answered as larger animals with lower surface area to volume ratio lose less heat than smaller ones. Small penguins huddled together to form a larger 'body' decrease their total surface area to volume ratio, resulting in reducing heat loss to the very cold environment. Information about how that heat was lost in terms of conduction, convection or radiation was not relevant to this question.

Question 2

(a) There were some excellent drawings, with clear continuous outlines drawn with a sharp pencil. Some were not much larger than the tooth in the photograph although a large drawing had been asked for. It should have been observed that the upper surface of the crown of the tooth was almost level with a central indentation, and that there was a curvature to the right at the base of the left-hand root.

(b) (i) 'Length' and 'width' for some candidates were interchangeable words. This led to lines being drawn horizontally from side to side across the tooth (width) instead of vertically from top to bottom of the tooth (length). Lines that were drawn diagonally could not be credited, neither could those drawn vertically but not at the point of maximum length or those that extended beyond the maximum length.

The vast majority of candidates measured accurately and recorded their measurements with correct units. There were a few candidates who mis-read rulers e.g. 33 mm instead of 38 mm, and even fewer who did not know how to read a ruler e.g. 30.8 instead of 38.

(ii) Many candidates correctly calculated the magnification by dividing their drawing measurement by the photograph measurement. Care should be taken in rounding decimal places. A few candidates included units with their magnification answer which meant that it could not be credited.

(c) (i) A number of candidates focused only on the safety aspect of this answer without describing a method that could be used to measure the pH of the plaque. The principal safety aspect should be that plaque should not be tested in situ but should be removed from the teeth before testing with Universal Indicator or a pH meter. The pH could then be determined by reference to a colour chart or reading the meter.

(ii) This proved a challenging question for many candidates. Good answers recognised that the regular lowering in pH took place at times after food had been consumed. Bacteria in plaque used food left on the teeth, especially sugars, in anaerobic respiration as a result of which lactic acid was produced which lowered the pH. Also the eating of acidic foods could lower the pH.

Common errors included that higher pH values are acidic, that plaque is the same as dental decay, or that saliva has a pH below 6.

(iii) This was another challenging question. However, there were candidates who, in comparing the graph of candidate Q with that of candidate P, identified that Q had no regular pattern of meals but was taking in food irregularly through the day which the bacteria in the plaque acted on. Hence the pH of Q's plaque was below 5.5 more frequently than P's, with such longer exposure to acidic conditions causing damage to the tooth enamel leading to dental decay.

(d) The vast majority of candidates realised that mouthwash had to be used in this investigation but there were a few who failed to mention this.

A number of candidates rightly recognised that such an investigation would need to be controlled and used a group of candidates who did not use mouthwash, or used water instead, to compare with the experimental group who did. Ideally, these two groups were of equal size.

The best answers made the use of the same mouthwash or no mouthwash the only variable in the investigation, stating that all the candidates should eat the same food and have the pH of their tooth plaque measured after eating this food as well as after using the mouthwash or not. There were candidates who mentioned measuring pH but failed to state that it was of the plaque – it could have been, for example, of the mouthwash so could not be credited.

More candidates correctly used 'volume' rather than 'amount' when referring to the mouthwash used. Better candidates mentioned other factors that should have been kept constant for both groups e.g. the length of time for which mouthwash or water was used, or the time interval between eating and pH testing.

A small minority of candidates wrote about the possible benefits of using mouthwash instead of designing an investigation to determine whether its use is beneficial. Such answers could not be credited.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key messages

This paper tests the ability to use a range of practical skills. Candidates should have experience of practical work, including biological tests and experimental design. Candidates should be able to select suitable apparatus for an experiment, be aware of potential hazards and be able to suggest appropriate safety measures.

General comments

The number of marks awarded overall covered the whole range available and it appeared that candidates had sufficient time to complete the paper. There were few instances of questions that were not attempted.

There continues to be improvement in the responses to questions relating to experimental design and more candidates are using precise terminology such as 'mass' and 'volume', rather than 'amount' or 'quantity' when describing measurements or listing variables to be controlled. There has also been improvement in the range of values chosen for the independent variable. To improve further, candidates need to be able to clearly describe the end-point of their investigation and what conclusions can be drawn from the results.

When asked to draw a graph candidates should ensure that instructions are followed when joining the points. If ruled lines are asked for, curves and lines of best fit are not creditworthy. The graph should make full use of the space provided and scales should be linear. Candidates should appreciate that unless a value for each axis is entered at the origin, it cannot be determined that the scales chosen are linear. Scale breaks should be used where appropriate.

Comments on specific questions

Question 1

(a) Candidates were asked to complete a results table using data that had been supplied in the question. Many candidates scored all 3 available marks and very few made errors in completing columns **C** and **D**. A small number of candidates did not complete the table heading or wrote seconds instead of minutes as the unit for time.

(b) There were some good answers here – the best ones analysed the results and provided a conclusion, i.e. the results from test-tubes **A** and **C** show that the enzyme is needed for protein digestion and the results from test-tubes **C** and **D** show that the enzyme works faster at the right pH. A significant number of candidates did not draw a conclusion but merely re-stated the result - that test-tube **D** was fastest because it contained both enzyme and pH solution.

(c) (i) Candidates were asked to suggest a suitable temperature for the water in the water bath and many did suggest a suitable temperature of between 35–45 °C. However a significant number of candidates stated their reason that it is the 'optimum' temperature rather than being close to the body temperature of a mammal. A small number of candidates suggested very low temperatures, e.g. 20 °C or high temperatures, e.g. > 50 °C.

(ii) Many candidates were able to suggest suitable pieces of apparatus and most candidates scored 1 or 2 marks.

(iii) Many candidates scored a mark for noting that distilled water was added to test-tubes **A**, **B** and **C** as a control. Better answers referred to keeping equal volumes in each test-tube, although fewer candidates stated this.

(d) Here, candidates were asked to design an experiment based on test-tube **D** to investigate the effect of pH on the action of the enzyme. This was generally well done with many candidates taking note of the method used in the investigation and the contents of test-tube **D,** and scoring full marks. More candidates than in previous years referred to 'volumes' and 'concentrations' rather than 'amounts' and also a range of pH values was specified rather than just stating 'acid' or 'alkali'. Often there was a reference to timing although few candidates explained clearly how they were going to recognise the end-point of their experiment, i.e. when the contents of the test-tube went clear, or what conclusion they could draw from that, i.e. the fastest one to clear would be the optimum pH.

(e) This question was generally well answered. Most candidates knew that the chemicals used could irritate the skin or be caustic. Occasionally the safety precaution did not relate to the experiment, e.g. use a water bath or a test-tube holder because the water will be hot (40 °C). Others mentioned a safety precaution without saying why it should be taken.

Question 2

(a) (i) This question was generally well-answered. Most candidates identified palisade cells; fewer correctly indicated a guard cell. A few candidates labelled the vascular bundle as one of these two cells.

(ii) This question was less well answered. Often, correct comparisons of the cuticle were given but there were far fewer good comparisons of the upper and lower epidermis; many just stating 'large/small' and omitting reference to the cells.

(b) There were some excellent drawings of the correct cells, using good clear lines. Most were of a good size with the relative sizes of the two cells well-represented and the three nuclei were drawn in most. Some failed to distinguish two guard cells, drawing them as one continuous cell. Only the two cells and one epidermal cell were required and should have been drawn together as seen; most were, although a few were drawn separately. It should be noted that drawings should not be shaded or stippled.

(c) (i) Most candidates drew a line as asked and measured both lengths accurately giving correct units. A few candidates mis-read the ruler and recorded 33 mm as 30.3 mm.

(ii) Most candidates knew the first stage of the calculation – that the measurement of their drawing should be divided by the measurement of the photomicrograph. In order to gain full marks candidates needed to take into consideration that the cells in the photomicrograph were magnified ×800 and apply this to their calculation.

The value for magnification should have no units and care should be taken when rounding decimal places.

Question 3

(a) Most candidates knew how to locate a pulse although there were some incorrect references to the pulse being felt in the veins, e.g. in the neck or wrist. As pulse **rate** was to be measured, there was a need to count the pulse beats over a given time. Some answers did not refer to counting and others did not mention time.

(b) (i) There were some excellently drawn graphs. Most were correctly orientated with the independent variable (time) on the x-axis. On some, the axes had no labels or incorrect labels, e.g. time/sec. Candidates should choose a scale to make the optimum use of the grid, e.g. the y-axis does not need to begin at 0 when the values to be plotted are between 84 and 180. There should always be a value at the origin of both axes and a scale break should be used where appropriate. In many instances the choice of scale made plotting more difficult than necessary. However, points were generally well plotted and most joined their points with ruled lines. If the question asks for points to be joined by ruled straight lines, hand-drawn lines or lines of best fit are not acceptable.

The majority of candidates drew a graph as instructed and not a bar chart.

(ii) Most candidates stated that the pulse rate decreased. In better responses it was noted that this rate of decrease was not constant, but slowed with time. A few wrote about the pulse rate falling during exercise which could not be credited.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key messages

Candidates should read questions carefully, ensure that they follow instructions and answer the questions fully and as set.

As stated on the front cover of the exam paper, candidates should show all working when asked.

Sharp pencils should be used for drawings and graphs.

Candidates should be familiar with the names and usage of standard laboratory equipment.

Candidates should appreciate the differences between reliability, validity and accuracy in investigations. The difference between length and width should be understood.

General comments

Candidates seemed to have adequate time to complete the paper.

Almost all scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written.

Graph and answers involving calculations were generally well answered.

Scientific terms such as ‘mass’ or ‘volume’ are becoming more widely and correctly used, rather than general terms such as ‘amount’.

Comments on specific questions

Question 1

(a) (i) An investigation is reliable if it can be repeated with similar results. A mean/average result obtained from several repetitions of the same investigation is more reliable than the results of carrying it out once. So, repeating the same investigation and calculating the mean/average result can improve reliability. A good number of candidates correctly stated this in their answers. Answers that could not be credited related to improving accuracy or validity rather than reliability. Other answers that could not be credited involved changing the method of the investigation so that it was not the same investigation that was being repeated.

(ii) Many candidates recognised that the hazard in this investigation was the hot water and stated that eyes should be protected with safety glasses/goggles, or that burning of hands could be prevented by using tongs to hold the test-tubes. Test-tubes could not be held in tweezers as stated by some. A number of candidates suggested wearing gloves but heat-proof gloves are not standard laboratory equipment.

(b) (i) Many well-constructed graphs scored full marks for this question.

Such graphs were correctly orientated with the independent variable (time) on the x-axis and the dependent variable (temperature) on the y-axis. Both axes were fully labelled with the value and

correct unit. A few candidates incorrectly labelled time in seconds – not having read the information given or the table header sufficiently carefully.

In the best graphs, suitable linear scales were used on both axes, with a value given at the origin of both. To make good use of the grid many candidates did well to choose to start the y-axis scale at a value higher than 0, or, if starting at 0, inserted a scale break to show that the initial part of the scale was not linear.

The majority of candidates plotted the points clearly and accurately. Care should be taken when choosing a scale. A few candidates used scales (e.g. 2 mm representing 1.5 °C) that may have made good use of the grid but made plotting accurately difficult.

The vast majority of candidates understood the instruction to construct two lines on one set of axes and labelled the two lines or made a key to identify them. Some omitted labels or a key. A few erroneously divided the grid into two halves, constructed two sets of axes and plotted one line on each.

Although instructed to join their points with ruled, straight lines, some candidates hand-drew lines or drew a ruled line of best fit which did not join the points.

Although there was an instruction to construct a graph, a few bar charts were drawn in error.

(ii) Many candidates followed the instructions and calculated the correct temperature of the water in the large test-tube at 3 minutes in °C, indicating with a line on their graph how they had worked this out. Frequently marks could not be awarded because no working was shown, or because the temperature of the water in the small test-tube had been calculated, or because no units were given with the temperature value.

(iii) There were many creditworthy conclusions expressed either in terms of animal size or of test-tube size i.e. heat loss was greater or faster in the small test-tube. A few candidates correctly answered in term of surface area to volume ratio i.e. the smaller surface area to volume ratio test-tube or animal lost less heat.

(c) (i) A good number of candidates applied the conclusion from the investigation to correctly suggest that penguins in the colder climate of the South Pole are larger than those found in the warmer climate of New Zealand. The best explanations related the larger penguin size to a lower surface area to volume ratio and hence a decrease in heat loss. It was important to recognise that the investigation was about surface area to volume ratio and not simply surface area as stated by a few candidates.

(ii) This was generally less well answered. Small penguins huddled together to form a larger 'body' decrease their total surface area to volume ratio, resulting in reduced heat lost to the very cold environment. Information about how that heat was lost in terms of conduction, convection or radiation was not relevant to this question.

Question 2

(a) There were some excellent drawings with clear, continuous outlines drawn with a sharp pencil. Some were not much larger than the tooth in the photograph although a large drawing had been asked for. It should have been observed that the upper surface of the crown of the tooth was almost level, with a central indentation and that there was a curvature to the right at the base of the left-hand root.

(b) (i) **'**Length' and 'width' for some candidates were interchangeable words. This led to lines being drawn horizontally from side to side across the tooth (width) instead of vertically from top to bottom of the tooth (length). Lines that were drawn diagonally could not be credited, neither could those drawn vertically but not at the point of maximum length, or those that extended beyond the maximum length.

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(ii) Many candidates correctly calculated the magnification by dividing their drawing measurement by the photograph measurement. Care should be taken in rounding decimal places. A few candidates incorrectly included units with their magnification answer that meant that it could not be credited.

(c) (i) A number of candidates focused only on the safety aspect of this answer without describing a method that could be used to measure the pH of the plaque and so could not score maximum marks. The principal safety aspect should be that plaque should not be tested in situ but should be removed from the teeth before testing with Universal Indicator or a pH meter. The pH could then be determined by reference to a colour chart or reading the meter.

(ii) This proved a challenging question for many candidates. Good answers recognised that the regular lowering in pH took place at times after food had been consumed. Bacteria in plaque used food left on the teeth, especially sugars, in anaerobic respiration as a result of which lactic acid was produced which lowered the pH. Also the eating of acidic foods could lower the pH.

Common errors included that higher pH values are acidic, that plaque is the same as dental decay, that saliva has a pH below 6 and that the action of salivary amylase produces acids.

(iii) This was another challenging question. However, there were candidates who, in comparing the graph of candidate Q with that of candidate P, identified that Q had no regular pattern of meals but was eating food irregularly throughout the day which the bacteria in the plaque acted on. Hence the pH of Q's plaque was below 5.5 more frequently than P's, with this longer exposure to acidic conditions causing damage to the tooth enamel leading to dental decay.

(d) The vast majority of candidates realised that mouthwash had to be used in this investigation but there were a few who failed to mention this.

A number of candidates rightly recognised that such an investigation would need to be controlled and used a group of candidates who did not use mouthwash, or used water instead, to compare with the experimental group who did use mouthwash. Ideally, these two groups were of equal size.

The best answers made the use of the same mouthwash or no mouthwash the only variable in the investigation, stating that all the candidates should eat the same food and have the pH of their tooth plaque measured after eating this food as well as after using the mouthwash or not. There were candidates who mentioned measuring pH but failed to state that it was of the plaque – it could have been, for example, of the mouthwash so could not be credited.

More candidates correctly used 'volume' rather than 'amount' when referring to the mouthwash used. Better candidates mentioned other factors that should have been kept constant for both groups e.g. the length of time for which mouthwash or water was used, or the time interval between eating and pH testing.

A small minority of candidates wrote about the possible benefits of using mouthwash instead of designing an investigation to determine whether its use is beneficial. Such answers could not be credited.