BIOLOGY

Paper 5090/11
Multiple Choice

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

General Comments

Most candidates showed a sound understanding of the subject. The nitrogen cycle (**Question 30**) and biotechnology (**Question 26**), and questions requiring interpretation of data (such as **Questions 10** and **12**) proved challenging for a number of candidates. Candidates need to appreciate the importance of reading a question, and all of its options, carefully before they choose an answer.

Comments on Specific Questions

Questions 2, 3, 11, 21, 23 and 38

These questions posed few problems for the great majority of candidates.

Question 5

Candidates did not always appreciate that the guard cells are a part of the leaf epidermis.

Question 6

This question had to be read carefully. It referred to diffusion into the cells, so the layer of moisture on the mesophyll surfaces was important, as well as the air spaces in the leaf.

Question 8

Candidates needed to appreciate that the dissolving of nutrients in saliva is an essential part of the digestive process – it is needed for chemical digestion, and is itself physical digestion.

Question 12

Candidates needed to look carefully at the diagram, the reading on the balance is the mass of both plant and water – so absorption of water into the root hairs (option A) will make no difference.

Question 14

This question, on the exchange of materials between capillaries and tissue fluid, proved challenging.

Question 18

A significant proportion of candidates thought that the depth of breathing decreases during exercise.

Question 28

Many of the stronger candidates were choosing option C (herbivores) as the most numerous group in the food chain. They must look at all four options carefully because the consumers (option B) include both herbivores and carnivores.

Question 34

Many candidates confused the pollen grain with the male nucleus.

Question 36

The signs of syphilis were not well known. This question attracted fewer correct answers than any other on the paper.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General Comments

Most candidates showed a good understanding of the subject. The nitrogen cycle (**Question 30**), plant reproduction (**Questions 34** and **35**) and biotechnology (**Questions 26** and **40**) were topics which some candidates found challenging.

Comments on Specific Questions

Questions 2, 4, 6, 7, 19, 21, 36

These questions posed few problems and were answered correctly by the great majority of candidates.

Question 3

Significant numbers of candidates thought that water moves towards a higher water potential.

Question 8

Candidates found this question challenging. They had to recognise that amylase is a protein, and therefore built up from amino-acid units. The most popular wrong answer was “urea”, which is produced as a result of the breakdown of amino-acids; it cannot be said to be built up from them. Candidates must read the question carefully.

Question 12

Candidates needed to look at the diagram carefully, the reading on the balance is the mass of both plant and water – so absorption of water into the root hairs (option A) will make no difference.

Question 14

This question, on the exchange of materials between capillaries and tissue fluid, proved challenging.

Question 15

Interpreting the data was a challenge for many candidates. A country with a lower age profile is likely to have a lower rate of coronary heart disease (CHD). On the other hand, “more males” in a country will have no effect on the percentage of males who suffer from CHD.

Question 18

A high proportion of candidates thought that the depth of breathing decreases during exercise.

Question 28

Most candidates interpreted “decreased reaction time” as meaning slower reactions.

Question 32

Some candidates chose option A thinking that energy availability increases along the food chain.

Question 34

Some candidates confused the pollen grain with the male nucleus.

Question 37

The functions of the hormones of the menstrual cycle were not well known.

BIOLOGY

Paper 5090/21
Theory

Key Messages

- Questions are designed to test discrete parts of a topic. Candidates should read the question carefully so that they include only the relevant information.
- Candidates should remember that a "suggest" question requires them to analyse the question and then to tailor their biological knowledge to provide an appropriate answer.

General Comments

There were some excellent answers from candidates showing a clear understanding of basic biological principles. However, in some questions some candidates had difficulty in applying this understanding to new situations.

Comments on Specific Questions

Section A

Question 1

(a) This question was well answered by candidates with good descriptions provided.

(b) Answers referring to water concentrations or water potentials are equally acceptable. Some candidates referred to the movement of the salt solution which did not gain any credit.

Question 2

(a) The parts of the heart were well known. Weaker candidates confused the right and the left sides.

(b) (i) Most candidates were able to indicate that the diameter of the arteries would decrease as the capillary beds were reached and that this would be followed by a gradual increase in the size of the veins as the blood neared the heart.

(ii) This question was generally well answered. References to the heart as the pump or source of the pressure, and the relationship between the distance from the pump and the resulting pressure were needed in this answer.

(c) (i) Many candidates correctly identified the semi-lunar valves and knew their function in the veins.

(ii) The candidates who identified structures **E** as muscles usually stated that they could contract. The effect of the contraction in causing squeezing of the vein and helping to move the blood upwards was not often seen. Some candidates incorrectly identified **E** as bones.

Question 3

(a) (i) About half of all candidates were able to identify that blood groups are an example of discontinuous variation.

(ii) Many candidates found it challenging to explain why the variation was discontinuous. Answers such as “the blood groups are discrete” or “there are no inbetween groups” or “a person has either one blood group or another” were all acceptable.

(iii) Most candidates either said that there were 6 300 000 or 6.3 million. Those candidates who answered 6.3 with no units given could not gain full credit.

(b) (i) Most candidates correctly calculated the missing percentage.

(ii) This was generally well answered. Candidates mentioned that the variation reflected the alleles of the original settlers in the country. As no definitive information was given, candidates also speculated about the countries, e.g. that they were islands or contained mainly people from a single ethnic group.

(c) Most candidates gained some credit for this question, usually for a reference to blood transfusions. Full credit was awarded where there was reference to other factors such as tissue rejection, paternity cases, the necessity to include the information on some official forms, forensic investigations etc. Some candidates gave examples of genetically linked diseases which were not relevant to this question.

(d) This was well answered. The most common error was to identify the genotypes of the parents and not the children.

Question 4

(a) (i) Candidates were generally able to answer this question correctly. It was necessary for the units to be stated (in this case, the day) for full credit.

(ii) This was usually answered correctly.

(iii) Candidates were instructed to use information from Fig. 4.1. consequently answers from some candidates such as “no intercourse took place” were not credited.

(b) The majority of candidates answered this question well, although only roles in the menstrual cycle were given credit. For example, references to oestrogen and its role in the development of secondary sexual characteristics were not relevant.

Question 5

(a) This question was only well answered by the strongest candidates. Candidates should have identified that the root hairs would be damaged when the plant was pulled from the ground and that there would be a time lag before new root hair cells grew and became functional. Many candidates erroneously thought that the plant would need time to adjust to the new unfamiliar soil environment.

(b) Most candidates were able to complete the equation correctly.

(c) (i) Most candidates identified the parts correctly, although some misnamed the epidermal cell.

(ii) Although this was answered well by some candidates, many stated that there would be fewer or no stomata on the upper surface. The explanation should have referred to why there are fewer here, rather than giving and explanation of why more are on the lower surface.

Question 6

(a) Only the strongest candidates were able to explain why digestion was necessary with the majority of candidates finding this question challenging.

(b) There were some excellent answers that gained full credit. Most candidates carefully read and then included the required references. There was some confusion among weaker candidates over the role of bile. Also, there was the implication in many answers that all the digestion occurs in the stomach.

Question 7

(a) This question was well answered by many candidates who named the structures and clearly explained how they changed. Some candidates used half of their answer to state the position of the components when looking at a near object which was not necessary.

(b) This question was generally well answered.

Question 8

Most candidates were able to list the main components of the blood and then explain the functions of each component. The answers for the red and white cells were very good. For plasma, few candidates said that many of the molecules were carried in solution and included the role of transporting heat around the body.

Question 9

(a) There were some excellent definitions of excretion.

(b) Candidates were familiar with the functions of the kidney machine and there were some very clear accounts which showed good understanding.

BIOLOGY

Paper 5090/22
Theory

Key Messages

Candidates should always read the questions and think carefully about what they have read before attempting the questions. In **Question 3**, a good deal of helpful information was present in the graph which could have been used to produce accurate answers. Likewise **Fig. 5.1** provided information which would have assisted candidates with their answers.

General Comments

Candidates were generally able to display a pleasing degree of competence in the syllabus topics covered by this year's paper and the credit awarded covered almost the entire available range. The areas that posed the greatest challenges were the interpretation of the graph in **Question 3**, the effect of transplanting seedlings and an understanding of nitrogen fixation.

Comments on Specific Questions

Section A

Question 1

(a) (i) Pollination was usually correctly mentioned, though a few opted for fertilisation.

(ii) This was usually correctly answered. A few candidates confused the stigma with either the style or the anther.

(b) Some suggested routes began in the middle of the style, and a significant number terminated in the funicle. The stronger candidates correctly took it through the micropyle to enter the embryo sac.

(c) (i) The question asked for the part of the carpel where the nuclei are *all* diploid. Ovary was not acceptable, while ovary wall was correct.

(ii) Most candidates selected a correct answer from a fairly extensive list of possibilities.

(d) The commonest correct response was "from a different species"', and this was the intended answer as the pollen grains are of different external appearance. A large number speculatively suggested that only one pollen grain was able to germinate, and that had already happened.

Question 2

(a) (i) Generally, answers were accurate; very occasionally, molars or pre-molars were suggested.

(ii) The clear majority realised that food needed to be stored in the alimentary canal, and were able to make a reasonable suggestion of which part that might be. A wide latitude of reasonable suggestions was accepted, but the commonest incorrect answer was mouth.

(b) The strongest candidates thought of supplying arrows to show the direction of energy flow. A number of candidates supplied the names of organisms none of which featured in the account of the sloth's trophic associates.

(c) (i) The provision of camouflage to protect the sloth from predators was regularly mentioned. Some ingenious suggestions were also made for the advantage of having green algae in the fur (protecting the fur from the sun, providing food for moths)

(ii) Several felt that burying faeces at the foot of the tree proclaimed ownership of that tree, but most realised the value to the tree, and subsequently to the sloth, of the faeces as a fertiliser.

Question 3

The graph was clearly explained on the paper, and candidates were assisted by the identification of the parts of the graph that related to the right atrium and the pulmonary vein. The interpretation of the information presented proved to be a challenge.

(a) Right ventricle was regularly seen, and many candidates realised that this was the answer as the right atrium supplies blood to the right ventricle. However, those that gave reasons related to blood pressure rarely indicated that it is within the ventricle that blood pressure shows the marked increase indicated on the graph.

(b) The fluctuations in pressure as blood passes along the pulmonary artery were rarely linked to the contractions and relaxations of the right ventricle. More commonly they were thought to be caused by breathing in and out. This suggests that these candidates were thinking about a graph on air pressure in the lungs during breathing.

(c) (i) Candidates usually correctly identified region **E** as the lungs.

(ii) Describing the changes – namely the loss of carbon dioxide and the gaining of oxygen by the blood, were quite common. However, few candidates explained those changes, thus there were few references to the action of haemoglobin or to the importance of diffusion gradients.

(d) In considering the blood pressure changes, candidates might have realised that, since the walls of the left ventricle are stronger than the walls of the right ventricle, then blood will be under higher pressure in the systemic circulation, and that this is necessary as the blood has much further to travel. There were occasional references to these points. Few appreciated that the greater (systolic) pressure would lead to wider pressure fluctuations in the arteries.

Question 4

(a) (i) Some thought that the upper epidermis would contain the greatest number of chloroplasts. The vast majority opted correctly for the palisade mesophyll.

(ii) In the main, this was well answered. The spongy mesophyll was thought by a significant number not to contain chloroplasts.

(b) Candidates must read the question carefully and think about the information given. Many noticed the open stoma and referred to it. It was common to read that the leaf was shown in the daylight hours " because it was photosynthesising".

(c) (i) A small proportion of candidates confused the position of xylem and phloem.

(ii) The functions of the two tissues was less well known than their positions in a leaf. Sometimes the xylem was said to carry water while the phloem carries mineral ions, and sometimes the phloem carried glucose or, too vaguely, "food".

(d) Reference to the increased concentration of carbon dioxide in the air space being partly the result of the stoma being closed was not often mentioned. Oxygen from photosynthesis was given as an answer and respiration was often said to begin as it gets dark, this was not awarded credit.

Question 5

(a) Methane and CFCs were quite regularly suggested, but sulfur dioxide, oxides of nitrogen and carbon monoxide were the common correct answers. Nitrogen was a common incorrect answer.

(b) (at **S**) References to the filtration of water and the treatment of sewage, while not uncommon, were not as common as references to reducing the pollution in the river and the harm to aquatic wildlife. Mention was often made of "recycling sewage" but a fuller explanation was required.

(c) (at **T**) Planting new trees was thought by candidates to be a form of recycling, and thus references to the recycling of paper and wooden objects were less common than expected.

Section B

Question 6

(a) Digestion in the mouth had been well learnt. Some candidates gave an account of the digestion of all classes of food stuff, but those who restricted their answers to starch usually gained most credit. The job of named teeth was not well described, many thought that teeth reduce the size of food *molecules* and some omitted to mention teeth at all. The functions of the tongue, of saliva and of salivary amylase were very well known.

(b) Some answers referred only to muscles "causing" food to be moved along, stronger answers referred specifically the contraction of circular muscles pushing food along. The idea that peristalsis is a wavelike contraction of muscles was quite often missed.

Question 7

(a) (i) It was generally known that the loss of water by transpiration, and the inability to replace it was the cause of wilting. Few candidates appeared to realise that it is the loss of pressure *within cells* that is responsible for a lack of support for the plant. Some thought that a lack of nutrients in the soil was responsible for the condition.

(ii) Few candidates realised that this process would damage the root hairs or have any effect on the root system at all. Many thought that older plants were able to store water and few mentioned that older plants gain some of their support from the xylem.

(b) This part was competently handled by most of the candidates. However some thought that the plant would absorb the salt by active transport (and sometimes by osmosis).

Section C

Question 8

(a) There were few references to the size difference between animal cells and bacterial cells. Otherwise, most of the marking points were seen, and full credit was reasonably common.

(b) There were few accurate accounts of nitrogen fixation. Most commonly, candidates gave an account of decomposition or of nitrification. That nitrogen is converted (into something) was awarded credit. There were few references to bacteria in leguminous root nodules and hardly any to free-living nitrogen fixers.

(c) A description of the effect of bacteria decomposing organic matter in the sewage – and the consequences of that were expected, however, most answers followed the route in which ions from sewage increased algal growth. Some candidates became side-tracked with reference to algae blocking out sunlight. However, those that went on to talk of the algae dying and bacteria decomposing them, using up oxygen for aerobic respiration gained most credit.

Question 9

(a) This part was generally well answered. However, some candidates need to clarify their understanding of the processes; the words haploid and diploid appeared in answers, but their relevance to the processes being described were not clearly understood. In some cases there

was the belief that meiosis occurs *in* gametes rather than during their production, and, for some, a description of meiosis was much nearer to a description of fertilisation.

(b) Candidates were successful in describing the advantages of asexual reproduction, however, they also needed to give 'a **named** example' of the process in order to secure full credit for this part-question.

BIOLOGY

Paper 5090/31
Practical Test

Key Messages

The main objectives of this paper were to test not only biological knowledge with emphasis on structure and function but also the application of practical skills and techniques. Requirements for doing well included in **Question 1** a clear understanding of why enzymes are used in the production of fruit juice on a large scale and the role of drying in the preservation of fruits such as the apricot. In **Question 2** key requirements includes an understanding of the structural differences between frog and human blood cells and how these differences are adapted for transporting oxygen around the body.

General Comments

The questions tested the ability of candidates to follow instructions, make and record accurate observations using written and drawing skills, in addition to taking measurements and performing simple calculations. The ability to accurately plot and evaluate tabulated data was also tested.

Comments on Specific Questions

Question 1

W1 -- 50 g crushed fruit + water **W2** – 50 g crushed fruit + enzyme (2% pectinase or pectolase)

(a) (i) The majority of candidates correctly completed both sets of readings, which showed an increase in volume and a clear or lighter appearance in **W2** compared with a lower volume and a cloudy or darker appearance in **W1**.

(ii) (iii) When suggesting reasons why the enzyme in **W2** was used, the best answers indicated that greater volumes of clear fruit juice were produced and that water was added to **W1** for comparison or as a control. Credit was not awarded for answers which primarily referred to the rate of juice production and that the addition of water simply diluted or increased the solubility of the solution.

(iv) Many excellent answers showed that stirring the contents of both containers resulted in an even distribution and that the enzyme in **W2** was thoroughly mixed with the crushed fruit.

(v) When considering what variables were needed to be kept constant during this investigation, excellent responses included temperature plus the volume, type, age, source or ripeness of the fruit. Answers which focused on the time taken without qualification and also environmental factors such as atmospheric pressure and humidity did not gain credit.

(vi) Candidates were asked to suggest three ways in which the investigation could be extended and improved and the best answers included repeating the experiment and taking a mean / average, using a longer time period to filter, measuring the mass or using a larger volume of crushed fruit before testing and also increasing the enzyme concentration. Answers which focused on starting experiments at the same time and at different temperatures and ensuring that clean / dry measuring cylinders were used were not awarded credit.

(b) When asked to a draw half of a fresh apricot (**Fig. 1.2**), candidates who gained maximum credit produced large clear drawings with the stone and pip shown in proportion and the point of attachment (**P**) to the parent plant was clearly labelled. Small drawings with poor quality lines, with shading and **P** incorrectly labelled were awarded no or only partial credit.

(c) (i)(ii) Excellent answers included appropriate preparation of the sample by cutting / crushing and adding Benedict's solution plus heat to produce the expected colour change from blue to red. Safety features included heating in a water bath or turning off the flames of a Bunsen burner or using goggles during the procedure. This was then followed in **(ii)** by correct statements being made about using the same volume of juice, the same reagents, heating temperature and period of heating and that the content of apricot juice was likely to be darker due to the presence of more reducing sugars.

(d) (i)(ii) In **Table 1.2** candidates were provided with data on changes in the **mass / g** of fruits such as apricot, which were left to dry over five days except for days 4 and 5. They were required to calculate the total loss in **mass / g** and in **(ii)** construct a graph to show this loss over the five day period. Strong responses not only correctly calculated the total loss in **mass / g**, but also produced graphs perfectly orientated with a linear scale and labelled axes (with the *x* axis as **time (t) / day** and the *y* axis as total loss in **mass / g**) and occupying over half the printed grid in both directions. Points were accurately plotted with a clear unbroken line passing through the plots.

(iii) When asked to suggest why drying the fruit over a period helps in preservation, the best answers showed that drying prevents the growth of decomposers. Credit was not awarded for statements that removal of moisture helps to stop metabolic processes by de-activating enzymes or simply stated that the fruit will last for a longer time.

Question 2

(a) (i) Excellent answers described oval-shaped cells and the presence of a nucleus in the frog compared with a round / circular shape and the absence of a nucleus in human cells. Some responses confused the cellular shapes and also identified a dark nucleus in blood cells of the frog compared with a light nucleus in human cells.

(ii) (iii) Some strong candidates calculated the actual length of the red blood cell of the frog by dividing the measured length of 10 mm given in **Fig. 2.1** by the magnification (× 5000) and similarly when given the diameter of a human red blood cell, the best answers correctly calculated the number of times larger this cell was in the human compared with the frog. To gain credit candidates must show their working in each section and divide the measured length of the frog red blood cell by the magnification.

(b) When explaining how blood is adapted for transporting oxygen around the body, the best answers clearly showed that in **Fig. 2.1** and **Fig. 2.2** the large number of small-sized cells results in a larger surface area / volume ratio. Some answers which did not gain credit commented on the shape of the cells allowing them to squeeze through the narrowest of vessels and the lack of a nucleus for example in the human blood cell allowed more room for haemoglobin.

BIOLOGY

Paper 5090/32
Practical Test

Key Messages

The main objectives of this paper were to test not only biological knowledge with emphasis on structure and function but also the application of practical skills and techniques. Requirements for doing well included a clear understanding in **Question 1** that when investigating changes in the length of potato strips placed in increasing concentrations of fruit juice in solution, movement of water occurs by osmosis through a partially permeable membrane down a concentration gradient. In **Question 2** a key requirement included procedures involved in safely testing the green areas of a variegated leaf for starch and in **Question 3** how structural features of lung tissue are adapted for gas exchange.

General Comments

The questions tested the ability of candidates to follow instructions, make and record accurate observations using written and drawing skills, in addition to taking measurements and performing simple calculations. The ability to accurately plot and evaluate tabulated data was also tested.

Comments on Specific Questions

Question 1

(a) The majority of candidates, when presented with a table containing known volumes and percentages of 4 solutions (**A B D E**) of fruit juices, satisfactorily calculated the unknown volumes of fruit juice and water of solution **C** where 50% of fruit juice in solution was known.

(b) (i)(ii) The best answers showed correct and realistically measured strips in mm or cm, with positive and negative signs to indicate appropriate changes or zero for no change. Some answers either omitted the positive or negative signs or included measurements of length / breadth / height of each strip.

(iii) When constructing a graph to demonstrate the results in **(ii)**, excellent responses showed correct labelling of the *x* axis as the concentration or percentage of fruit juice and the *y* axis already labelled as change in length of potato but linear scales with numerical and negative values added. In addition five plots were correct and joined with ruled lines or a smooth curve and occupying at least half of the grid on both axes. Some answers lacked fully labelled axes with incorrect plots and poorly drawn lines through the plotted points.

(iv) When suggesting why changes in the lengths of the potato strips occurred in different solutions, the best responses showed that movement of water occurs across a partially permeable membrane by osmosis. The uptake or loss of water was related to lower or higher percentages / concentrations of the respective fruit juice solutions or that no water movement occurred with no change in length.

Many incorrect responses omitted reference to partial permeability of the cell membrane and confused water movement with water potential / absorption.

(c) Candidates were asked to suggest three improvements that could be made to improve the reliability of this investigation and many excellent answers included replication plus calculation of a mean / average, together with taking strips from the same type / species of potato and cutting to the same thickness / mass / surface area. The use of smaller increments of fruit juice concentrations and leaving strips in the solutions for a longer or the same length of time were also correctly referred to. Answers which simply referred to the use of measuring cylinders or magnifying lenses

for accuracy or that strips should be accurately cut / measured and placed under the same external conditions were not awarded credit.

Question 2

(a) (i) Strong candidates produced clear, clean and continuous outlines, at least 100 mm in total length with the green area delimited and the midrib drawn with a double line plus 8 veins. Two labels from either the lamina / petiole / midrib / veins were also correct. Some candidates omitted the labels and / or confused the midrib and petiole.

(ii) When describing the methodology used to safely test that the green areas of the leaf contained starch, excellent responses described the immersion of the leaf in hot water followed by ethanol / alcohol to remove the chlorophyll or to decolourise the leaf. This was then placed again in water to remove the ethanol / alcohol before adding iodine solution. Safety measures included water being heated in a water bath or that Bunsen burners should not be used or at least turned off to avoid naked flames. Many incorrect responses either omitted to mention safety altogether or only described the iodine test.

(iii) When describing what areas of the leaf would look like at the end of the test, the best answers showed that the green areas would be blue-black / black and the white areas yellow / brown / yellow-brown. Incorrect responses referred to the green colour changing to blue and that the white colour remained the same.

(b) (i) The majority of candidates correctly recorded the number of stomata on the lower surface of a similar leaf shown in **Fig. 2.2**.

(ii) Calculations of the actual length of the guard cell from the measurement given in **Fig. 2.2** and dividing this by the magnification were generally well done. There were a some responses where the measurement was multiplied by the magnification.

Question 3

(a) (i) Only a minority of excellent answers explained that the small artery labelled in **Fig. 3.1A** comprised a thick wall with a folded, wrinkled inner layer and a small lumen. Candidates, who did not gain credit, focused on the artery possessing a large lumen, surrounded by capillaries or that the artery was located opposite to the vein.

(ii) When asked to name the structure labelled **Z** in **Fig. 3.1A**, only a minority of correct answers referred to this as the alveolus or air sac. The majority of incorrect responses identified **Z** as a lung cell, bronchiole, vein, artery, red / white blood cell, plasma or this remained unanswered.

(b) (i) When describing how healthy lung tissue is adapted for gas exchange, the best answers mentioned the presence of thin walls or that they were one cell thick with many alveoli and a network of capillaries providing a good blood supply and a large surface area allowing diffusion to occur. Many candidates either left this section blank or referred to the healthy tissue as absorbing / releasing oxygen and carbon dioxide or simply repeating the term “gas exchange” given within the question.

(ii) The best responses referred to fewer capillaries and fewer / large alveoli with thicker walls and larger lumens being evident in diseased lung tissue. Some candidates either left this section blank or stated that diseased tissue showed thick capillaries and that less red blood cells flowed through the vessels within this tissue.

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5090 Biology November 2015
Principal Examiner Report for Teachers

BIOLOGY

Paper 5090/61
Alternative to Practical

Key Messages

It is important that candidates have experience of practical work, including biological tests and experimental design.

Candidates should be familiar with the concept of variables and the reasons why they should be controlled.

They should understand the difference between the terms accuracy and reliability.

It is important that candidates read the questions carefully to ensure that they answer them correctly.

When the question asks about visible features, credit cannot be given for answers that relate to features that cannot be seen.

General Comments

It appears that candidates had sufficient time to complete the paper. The majority of scripts were clearly legible, with the answers written in the spaces provided.

There has been a notable improvement in the responses to questions relating to experimental design. To improve further, candidates should be aware of the importance of describing clearly how the results are to be measured or obtained.

Comments on Specific Questions

Question 1

(a) (i) Candidates were asked to record the volume of juice collected from the 2 samples as shown in Fig. 1.1. The majority of candidates answered this correctly.

(ii) The question asked for 2 reasons why the enzyme is used in the large scale production of the fruit juice. Better candidates noted that there was a larger volume of juice which was also clearer than the juice produced without the use of the enzyme. Some candidates gave only one reason and others made general statements about enzyme action which were not related to the question.

(iii) Candidates were asked to suggest why water was added to the crushed fruit in sample B. Many gave creditworthy responses here relating to the comparison of the 2 samples (A and B), the use of a control or to discover the effect of the enzyme. A few stated that it was to discover the effect of water, which by itself was insufficient. A significant number incorrectly thought that water was added to aid filtration.

(iv) In this question, candidates were asked to state 2 variables that needed to be kept constant in the investigation. The best answers were specific and clearly described a control variable, such as 'volume of crushed fruit' or 'concentration of enzyme'. A significant number of candidates in referring to the crushed fruit used the words 'amount' or 'quantity' instead of 'volume' or 'mass'. It should be noted that candidates are expected to demonstrate the knowledge of correct terminology when describing how to measure quantities of different substances.

Many candidates correctly referred to other variables including temperature and age of fruit.

(v) Candidates were asked to suggest how the investigation could be improved to increase the reliability of the results. In better responses candidates suggested repeating the experiment and calculating the mean. Other acceptable responses included reference to the use of the optimum temperature for the enzyme, increasing the concentration of the enzyme and measuring the mass of the fruit before testing, amongst others. Some candidates continue to confuse reliability with accuracy and references to accuracy of measurement and avoiding parallax error were not credited.

(b) There were some very good drawings twice the size of the fruit shown in Fig. 1.2. The best responses demonstrated a good biological drawing technique using a sharp pencil to draw clear continuous lines with no shading.

Weaker answers showed a lack of good proportions and were not able to identify the point of attachment.

(c) Candidates were asked to describe how you could safely test a sample of fruit to show that it contains reducing sugars. Many candidates knew that Benedict's solution could be used to test for the presence of reducing sugar, and that once added to the test material, it should be heated. The colour change to green, yellow, orange or red was well known but often candidates did not describe the original blue colour of the solution. Some candidates incorrectly applied biuret reagent or iodine solution.

The question asked how the test could be carried out safely. Some candidates mentioned the use of a water bath, eye protection or tongs which were credited; however some candidates omitted the safety feature.

A few candidates included the use of hydrochloric acid and sodium hydroxide which are used to test for non-reducing sugars and therefore could not receive full credit for their answers.

(d) (i) The vast majority of candidates were able to calculate the loss in mass for days 4 and 5 correctly.

(ii) There were some excellent graphs. Most were of a good size with clear, accurately plotted points and good lines. Some candidates used the wrong orientation or did not label the axes fully and others plotted time against mass, rather than time against loss in mass, which was required in the question. A significant number of candidates omitted 0 at the origin.

(iii) Better candidates realised that removing water prevented the growth of decomposers. Some candidates stated that decay would be prevented but did not indicate what might cause that decay.

Question 2

(a) (i) Many candidates were able to describe the difference in shape between the frog and human blood cells. Fewer candidates demonstrated awareness that human red blood cells do not have a nucleus.

(ii) Candidates were asked to calculate the actual length of cell X. Many were able to do this correctly and produced good answers. Sometimes in recording the value, units were not given. As no units were given on the answer line, units should have been included. When candidates calculated the answer incorrectly generally this was because they divided the magnification by the size of the image.

(iii) Many candidates were able to calculate correctly that a human red blood cell is 3.5 times larger than a frog red blood cell. The majority of those that did this incorrectly calculated the difference between the sizes of the cells instead.

(b) Here, candidates were asked to use features visible in Figs. 2.1 and 2.2 to explain how blood is adapted for transporting oxygen around the body. While some candidates explained this accurately, many candidates introduced features that were not visible e.g. the presence of haemoglobin. Others described the flow of blood carrying oxygen round the body.

Question 3

(a) (i) This question was only answered well by the strongest candidates.

(ii) Many candidates realised that the drying agent would help to ensure that there were the desired areas of different humidity in the apparatus. The disadvantage in terms of the possible effects on the behaviour of the beetles was often poorly expressed.

(b) (i) Many candidates correctly identified light or heat as a possible variable.

(ii) Many of the suggestions did not address how the effect of the uneven distribution of light or heat might be reduced.

(c) There were some good answers to this question using similar apparatus but in some way creating light and dark areas. Many candidates put the beetles into the apparatus and waited for some time for them to respond. Better candidates realised that that other environmental conditions e.g. temperature and humidity should be kept constant, and took steps to demonstrate this by removing the wet and dry paper or by suggesting that the paper be either all wet or all dry. Weaker candidates kept the wet and dry areas in this experiment as well as creating differences in light.

A small proportion of candidates clearly stated that they would count or record the number of beetles in each area, however the majority of descriptions regarding the collection of results were vague.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key Messages

This is a practical-based paper; it is expected that candidates will have had experience of practical work.

Candidates should always read the questions carefully to ensure that their answers relate to what is being asked.

Drawings should be made with a sharp pencil, without shading. Ruled lines should be used only for labelling where required.

General Comments

The majority of candidates expressed themselves well and their writing was clearly legible.

Almost all the candidates attempted all the questions.

Comments on Specific Questions

Question 1

(a) The majority of candidates were able to calculate the volumes of fruit juice and water needed to prepare a 25% fruit juice solution.

(b) (i) Many candidates measured the five drawn pieces of potato accurately. The column header in the **Table 1.2** in which measurements were to be recorded read "final length of potato piece/mm", however, some candidates recorded measurements in centimetres.

A few candidates read measurements from a ruler incorrectly recording, for example, 80.2 instead of 82.

(ii) Many candidates were able to calculate the changes in length of the five pieces correctly and record them with negative signs where the length had decreased or a statement that there had been a decrease in length.

A number of candidates mistakenly confused the negative and positive changes.

Candidates must read the question and the headers of the columns in **Table 1.2** carefully**.** Some candiates erroneously subtracted the **final juice concentration/%** numbers from their measurements.

(iii) Some excellent graphs were drawn which gained full credit.

Most candidates labelled the *x* axis fully with the independent variable, fruit juice, and %. However, many did not complete the dependent variable label, change in length of potato piece, provided on the *y* axis by adding units, mm.

As the *x* axis had been drawn at 0 on the *y* axis, therefore the values on the *y* axis below that 0 were negative values but sometimes the negative sign or negative values were omitted.

The linear scales chosen by the candidates usually made the best use of the grid. The majority of candidates chose suitable scales.

Most candidates were able to plot their data precisely and to join their plotted points with a smooth curve or ruled lines, without extrapolating them.

(iv) Some candidates, recognising that osmosis had occurred, wrote answers giving details of what osmosis is that were unrelated to the investigation. It was expected that candidates would be able to suggest that the changes in length were due to movement of water, into some potato pieces and out of other pieces. As the potato strips were clearly identified with letters, those letters should have been referred to in explaining what had happened.

Some candidates correctly stated that this water movement occurs across a partially permeable membrane.

Movement of solution or fruit juice instead of water could not be credited, neither could references to diffusion instead of osmosis.

(c) The most frequently stated methods of improving the reliability of the investigation were those of repeating the investigation or using larger numbers of potato pieces. These methods only improve reliability if the mean result is calculated or any anomalous results are identified. Stronger candidates recognised the need to find the mean.

Other good answers related to measuring the change in mass of the potato pieces or that all the potato samples should be taken from the same potato or variety of potato.

Some recognised that different concentrations of fruit juice could be used but described using a greater range; this could not be credited as the range already used was from 0% to 100%. A few candidates stated that the use of smaller increments in concentration, for example 5% 10%, 15% etc. could have added to reliability.

Question 2

(a) (i) Many candidates made good drawings of the leaf in **Fig. 2.1** but some omitted the labels.

The technique of drawing smooth continuous lines rather than short sketchy ones has been mastered by most candidates. This technique is helped by the use of a sharp pencil.

If a large drawing is requested then it should larger than the specimen provided.

Although the midrib of the leaf looks fairly straight, it should not be represented by a ruled line. Most biological specimens do not have features with such rigid straight lines.

(ii) Some candidates found describing how to test the leaf safely to show that the green area contained starch after being left in the light difficult. There were several marks available for the description; the use of iodine solution was awarded partial credit. Stronger candidates recognised that, in order to have a clear result, the green pigment had to be removed. The leaf was boiled in water to make it more permeable and then in alcohol to remove the chlorophyll. The safety feature should have related to the heating of the flammable alcohol – a water bath should be used with no naked flames or lit Bunsen burners nearby.

Candidates needed to read the question carefully. Some described other investigations involving photosynthesis in leaves which were irrelevant to this question.

(iii) Most candidates worked out that the green areas of the leaf that contained chlorophyll would have been able to photosynthesise and produce starch that resulted in a positive blue-black result with iodine solution. The areas of the leaf without chlorophyll would contain no starch and take on the original colour of the iodine solution. Some stated incorrectly that the white areas would remain white.

(b) (i) Nearly all of the candidates were able to identify the stomata in **Fig. 2.2** and count them.

(ii) The measurement of the line **Y-Y** was generally done with precision. Some chose to record their measurement in centimetres, others in millimetres; both units were acceptable here. Some omitted units from this question so could not receive full credit.

Many candidates were able to use the information on **Fig. 2.2**, i.e. that the image was magnified × 500, to calculate the actual length of the guard cell correctly; they divided their measured length by 500. Some, in error, divided 500 by their measured length or multiplied their measured length by 500. Candidates when reviewing their answers should recognise that guard cells are never many millimetres long.

Question 3

Many candidates read through all the information provided about this investigation and were able to appreciate how the practical was done. This was reflected in their good answers.

(a) Stronger candidates identified the diameter of the paper cylinder or the way the paper was rolled up as variables that should have been kept constant in this investigation. Other constant features should have been the nature of the paper used to make the cylinders, the position of the hook on the cylinder and the mass of the actual hooks (without the added masses).

Answers which stated that the distance between the stands should have been kept constant could not be credited; as the investigation was into the effect of length on the strength of bones the distance between the stands had to be varied. No credit could be given to answers that the masses should be kept constant or that the height of the stands should be kept the same.

(b) (i) Most candidates were able to identify that the trend shown by the results of the investigation was that as the length of the "bone" increased the mass needed to bend the "bone" decreased. The relationship was an inverse one – but not inversely proportional as some stated.

Answers which implied that decrease in mass caused the length to increase could not be credited.

(ii) Many candidates related this answer to the aim of the investigation – to test the idea that the longest bones were the strongest**.** Some simply stated correctly that longest bones were not the strongest or that shorter bones were stronger than longer bones or that the candidates' idea was wrong.

Candidates need to distinguish between a 'trend' and a 'conclusion'.

(c) There were some excellent investigations designed to find out whether thicker "bones" are stronger than thinner "bones".

The length of the "bones" was kept constant while the thickness of the "bones" was varied in different ways e.g. making tighter or looser rolls of the same sized paper, rolling layers of similar paper together or using rolls of paper of different thicknesses.

Again masses were added until the "bone" bent and the length of the "bone" and mass needed for bending it were recorded.

Some candidates changed the apparatus to use of materials other than paper e.g. wood, metal or actual bones but these could not be credited.

A number of candidates predicted the result which could not be credited. What was credited was that the more mass needed to cause bending, the stronger was the "bone".