BIOLOGY

Paper 5090/11
Multiple Choice

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

Key Message

As always candidates must read all the words before coming to a decision; the last three words of **Question 3** illustrate this point well.

General Comments

There were some surprises, such as **Question 28**, which was expected to be too easy and **Question 40**, which was not well known. It was pleasing to see that in **Question 34**, 73 % of candidates knew the advantages of breast milk.

Comments on Specific Questions

Questions 1, **5, 8**, **13**, **23**, **34** and **39** were correctly answered by most candidates.

Question 2

Options **A** and **B** are diffusion, while **D** is osmosis – all of which are passive. The complete uptake of glucose from the gut requires active transport

Question 3

Most candidates realised that osmosis was involved but as water enters the potato tissue, the concentration of the solution in the test tube must be increasing.

Question 4

Starch is hydrolysed faster by amylase at 35 °C than at cooler temperatures, but the enzyme is denatured at 90 °C. Also, knowing the classic starch test – blue/black colour with iodine solution - is necessary. In option **B**, no hydrolysis occurs at 90 °C, but the reaction takes place faster at 20 °C than 35 °C and not at all at 10 °C, which is unlikely. Option **C** has the greatest activity at 90 °C at which temperature amylase is inactive. Option **D** (which was far too popular) shows the enzyme active at 90 °C and 10 °C, but not at 35 °C or 20 °C.

Question 6

The hydrogen carbonate indicator in tube P will be purple as the green plant photosynthesises.

Question 7

Graph **B** shows photosynthesis still increasing at 70 °C, which it normally does not.

Question 9

Muscle layer S and P are shown to be longitudinal in the diagram and layer Q and R are circular, as shown by the dots which are seen in this longitudinal section.

Question 10

The red cell, **A**, has no nucleus, unlike the white cell **C**, which has little or no haemoglobin.

Question 11

In the vascular tissue, R labels a sieve plate so it must be phloem, whilst Q is xylem.

Question 12

Both starch tests are negative, since neither cell transports starch. The sugars in the phloem element will include some glucose, but no starch.

Question 14

The vessel is a vein since it has a valve and blood can only flow from right to left in the diagram. Hence the heart must be next (Key **A**) since all veins take blood to the heart. Blood in the hepatic portal vessel flows from the gut to the liver, but not the other way. Option **D** was far too popular and refers to the pulmonary artery, not the vein.

Question 15

The highest pressure must be the aorta, P. Similarly the pulmonary artery (R) pressure is higher than the pulmonary vein (S).

Question 16

Human anaerobic respiration does not produce CO_2, but yeast does.

Question 17

The diagram and the table refer to the external intercostal and diaphragm muscles, both relax when exhaling.

Question 18

Exhaled air contains about 4 % CO_2, but the % of nitrogen will remain about the same as in the atmosphere.

Question 19

In order to straighten the hinge joint at the elbow, a muscle must be attached at 2. Points 3 and 4 are for the biceps.

Question 20

Blood is pumped through a kidney machine by Z, so the key must be **C**. The dialysate entering (X) is kept at the correct temperature.

Question 21

Fat is an insulator. Active secretion of sweat uses and releases energy, but only occurs when the body is overheated.

Question 22

Refraction occurs at a surface when light passes to a different density material. Most refraction occurs at P, the conjunctive / cornea. Fine focus adjustments are made by the adjustable lens, R. The muscle ring Q controls light intensity reaching the retina.

Question 24

Adrenaline prepares the body for 'fight or flight' and raises blood glucose levels.

Question 25

Nicotine is the addictive drug in tobacco smoke, but it is not carcinogenic at low levels.

Question 26

The bacteria, either occurring naturally or added during the processes, produce acids which coagulate the proteins.

Question 27

Anaerobic respiration by the yeast will not release lactic acid. The alcohol produced will evaporate. The CO_2 causes the bread to rise.

Question 28

Energy cannot be produced, just transferred. All food chains begin with producers, which capture solar energy and supply the carbohydrates, which are the energy source for the organisms in the chain.

Question 29

Option **A** was popular but suggests that the organisms on the fallen leaves (S) are consumed by the plants P and Q. The key **C** shows energy passing from the plant Q to the herbivores R and S.

Question 30

The pyramid of numbers shows many grass plants, few cows, many insects and fewer birds.

Question 31

It well known that bacteria cause syphilis, but far too many candidates still think that malaria is caused by, rather than just carried by, mosquitoes.

Question 32

Negative questions need careful thought. **B** gives the incorrect statement about fishing nets. With smaller holes in a net, smaller, younger, immature fish will be caught before they can reproduce. This could cause the collapse of the fishery. Similarly, larger holes in the net will allow more, larger fish to escape and reproduce.

Question 33

70 % of candidates chose **C** – an ovule that has been fertilised. It will have half of its chromosomes from the parent plant and the other half from the pollen grain. The cells of the stem (key **D**) can be grown into clones of the parent plant.

Question 35 .

Sadly, 40 % of candidates still did not know that ovulation (and hence fertility) is likely 14 days after menstruation begins.

Question 36

The stem refers to the activation of enzymes during germination, which do not normally require light.

Question 37

Crossing two heterozygotes will produce a 3 : 1 ratio. The cross of aa x Aa will produce 1 : 1.

Question 38

The AB parent cannot produce an O group child, since I^A and I^B are co-dominant.

Question 40

Recessive phenotypes must be homozygous. Hence the probability of 1.00, but this is not well known

BIOLOGY

Paper 5090/12
Multiple Choice

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There were some surprises, such as **Question 24**, which was expected to be too easy and **Question 40**, which was not well known. It was pleasing to see that in **Question 38**, 73 % of candidates knew the advantages of breast milk.

Comments on Specific Questions

Questions 1, **4**, **10**, **12**, **23**, **26**, **29**, **36** and **38** posed few problems for candidates.

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Most candidates realised that osmosis was involved but as water enters the potato tissue, the concentration of the solution in the test tube must be increasing.

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BIOLOGY

Paper 5090/21
Theory

Key Message

Candidates should be reminded of the need for responses to be clearly legible. If any changes are necessary there should be a clear cancellation and the new work rewritten in an unused space.

Candidates should also be reminded to read questions carefully before writing their response to avoid any misinterpretation and to establish what is being asked.

General Comments

The work of the candidates in general was well presented and legible. Most of the candidates were able to give relevant answers to the questions and the time available seemed to be adequate. Only a few candidates ignored the rubric and attempted both **Question 8** and **Question 9**. There were some excellent answers. However, others showed difficulty in understanding the underlying biological principles of some of the questions. In **Section A** the material may be presented in an unfamiliar way but the required answer is always based on syllabus knowledge. It is necessary to study the questions very carefully to determine precisely what is required before framing the answer otherwise useful information may be overlooked.

Comments on Specific Questions

Section A

Question 1

(a) The criteria for recognising the different types of cells were well known but the significant features for each of **A**, **B** and **C** were not often selected. Only rarely was full credit awarded, even to very good candidates. **A** (bacteria) and **C** (animal) were often recognised but when **B** was recognised often no reason was given.

(b)

(i) This was generally well done; a few gave negative answers e.g. no cell wall, or cytoplasm / nucleus present.

(ii) Again this was well known, although the starch store was sometimes said to be in a vacuole not in the chloroplast as shown in Fig. 1.2.

Question 2

(a) Most candidates correctly identified the type of reproduction, though some confused the two, and it was not unusual to see 'asexual' given on both lines. There were candidates who named the different methods of pollination or procedures such as budding / grafting.

(b) The fact that it was a crop of bananas being produced was largely overlooked. As a result of asexual reproduction, once the desired characteristics of the fruit had been selected the growers would know that the bananas would consistently be all of the same quality and

size; however there were few references to the fruit and most credit was given for higher yield / greater profit or faster production.

(c) Many candidates gained partial credit but only a few enough detail to receive further credit. It was often explained that the hyphae spread through the intercellular spaces, and the leaf died, but since this information was given in the question it did not receive credit. Commonly, reference to blocking of stomata / interference with the movement of gases, the effect on photosynthesis, and the idea that the fungus deprived the leaf of nutrients gained credit, other points occurred only occasionally. There was a not uncommon confusion of the term 'spores' being used to mean (presumably) 'pores' and used for 'stomata'.

(d) There was a common belief that the cultivated bananas would automatically have less resistance to fungal diseases than the wild ones. Those who stated that the cultivated plants were genetically identical did not always go on to say that this meant that if one plant was susceptible then they all would be. Few referred to the fact that the cultivated plants would be growing close together, although credit was sometimes awarded for the idea of the wild ones growing well apart from each other.

Question 3

(a) Candidates did not always appreciate the difference between detecting / receiving a stimulus and sending it to the brain. Where a specific stimulus was named it was almost invariably correct. Many candidates suggested that the sensors 'controlled or regulated body temperature'.

(b) Overall a lack of clear understanding was evident here. The connection between the sweat glands and the capillaries was rarely given though the idea of dilation was well known. A frequent misconception was that the capillaries move towards the surface of the skin. Some candidates 'burnt' the fat under the skin or described how heat is formed in the body but few stated that blood carries heat.

(c) Almost all candidates gained credit for knowing that high altitudes would result in very cold environments.

(i) The more able candidates realised that in cold conditions the animals did not need to lose heat, that in fact, it would be detrimental so that sweating was unnecessary. Many found it difficult to express this idea clearly. There were few references to the fur inhibiting the evaporation of sweat; many stated that the fur was there to 'keep it warm'.

(ii) Both the energy release from the stored fat and its use as an insulation layer were well known, though both were not always given. Candidates needed to elaborate on the idea that food is stored for later use.

(iii) There were some innovative ideas, but even though the animal was described as being 'compact' with short tail and small ears this did not alert candidates to the relationship between surface area and consequent heat loss.

Question 4

Candidates rarely find the interpretation of graphs easy and frequently do not extract all the information available for them to use in their answers; this was the case here.

(a) The majority of candidates gained credit for stating that since grass plants have short roots they would be unable to reach water and some realised that there was less water near the soil surface, and that the grasses were grazed. Apart from an occasional

reference to a lack of water for photosynthesis, no other reasons were given for the decline. There was a widespread idea that trees store water in their trunks.

(c)

(i) The graph seemed to be difficult to understand and the time scale was not always taken into account which resulted in candidates drawing the wrong conclusions.

(ii) There were few correct responses, with less than 1% mentioning natural selection / mutation. Many explanations were confused and did not make the deduction that longer necks enabled the animals to feed on vegetation beyond the reach of those with shorter necks and so survive and breed. Odd reasons were given for the increase in neck length e.g. it was seasonal.

Question 5

The standard varied widely with some excellent, accurate answers in stark contrast to those who struggled to produce a meaningful response.

(a) Mainly correctly answered though frequently DNA was given in **(i)** and chromosome in **(ii)**.

(b) The majority of candidates understood the term 'contrasting characters' and gave a correct answer.

(c)

(i) The phenotype of one recessive character was asked for, sometimes only the genotype was given. If the phenotype was correct, a correct reason usually followed.

(ii) All genetic diagrams should be neatly presented and fully labelled. The question indicated that more than one diagram was required but very few gave a cross between a recessive and a homozygous dominant <u>and</u> one between a recessive and the heterozygote, though there were some good answers. Candidates were free to use the letter of their choice to represent the gene; it was expected that convention would be followed with an upper case letter used for the dominant gene and the lower case (identical) letter for the recessive. This was not so. Mismatched letters e.g. WW x SS were used. The labelling was often inadequate or completely lacking e.g. it was not uncommon to see this on a page, with no names, key, or labels:

Ww x ww
Ww Ww ww ww

Many candidates did a wrong cross i.e. did not use a recessive as one of the parents. A clear diagram, properly labelled, with gametes shown or labelled scored well even if only one cross was done.

Section B

Question 6

(a) There were some very good answers where candidates easily gained full credit, but these were few in number. In contrast many candidates could make no response at all. The remainder attempted the question but were unable to provide accurate details. The first part required the preparation of genetically modified bacteria that would then produce the desired hormone, followed by an outline account of the culturing of the bacteria to produce commercial amounts. There were many confused ideas, the gene must first be cut from

the chromosome of an appropriate cell but in many answers the hormone was cut out and used. Many believed that bacteria may be injected into the body to produce insulin, and also that a bacterium is a fungus. Most of the candidates made use of enzymes but did not always name the origin of the cell used. The microorganism to be used was usually identified as a bacterium, sometimes it was even named. There were some candidates who gave a good account of the preparation but did not go on to produce the hormone, while others only knew about the culture process. There were some, triggered perhaps by the reference to 'commercial', who described the production of yoghurt or cheese.

(b) Credit was awarded for yield and reference to 'cheaper'; other ideas were rare. There was an occasional mention that there would be no side effects if the hormone was used in humans, and that producing the hormone using microorganisms avoided the necessity of killing animals.

Question 7

(a) Candidates answered this question with confidence despite the deficiencies in some of their answers. Many spent time describing events leading up to fertilisation or gave details concerning the end of pregnancy and birth which were outside the remit of the question. There were some excellent answers receiving full credit but also some weak ones which did not describe events in chronological order. Most candidates started off with a zygote but the progress to embryo and fetus was muddled with the terms being used interchangeably. Cell division was not always by mitosis. Implantation most often happened on the wall of the uterus rather than its lining, but a reference to the placenta usually gained credit. It was known that there was no mixing of maternal and fetal blood but the exchange of waste products and nutrients was described only in general terms, often with no specific substances being named, though oxygen transfer was noted by some candidates.

(b) This was well done on the whole and all points were given. A common misconception was that bottle milk was deficient in some nutrients which would result in poor mental development whereas it is only the proportions of the nutrients which differ from breast milk.

Section C

Question 8

This was the preferred option of most (80 %) of the candidates.

(a) Credit was awarded for the names of the chemicals excreted e.g. not urine but any of its constituent excretory chemicals. Bile salts were accepted (not just the secretion of bile). A popular list was urine, faeces and carbon dioxide, as opposed to, urea, water, carbon dioxide (and salts). Hormones were sometimes included but they were not broken down and thus only secreted not excreted.

(b) Candidates were able to gain partial credit here even if their account was not comprehensive. 'Kidney' gained credit provided it was linked to one of its constituents which should be carried to it in the blood. Further credit was awarded if an accurate account was given of the urinary tract. There were, however, errors in the spelling of the names of, and the functions assigned to, the ureter and urethra. Urine was not always named, and there was confusion between urea and urine. Carbon dioxide usually gained credit (the diffusion from the capillaries was rarely given) but candidates did not always make the exhalation / expiration point very clearly. Sweating presented the opportunity to gain further credit but a mention of carriage in the blood was lacking. Here and in **Question 3(b)** candidates showed a lack of detailed knowledge of the structure and function of the sweat glands, however, most candidates gained partial credit for a

description of the sweating process. A few candidates correctly referred to the removal of bile salts in the faeces, but faeces were often used to remove many substances that were not excretory.

Question 9

(a) Candidates usually selected two or three chemicals from carbon dioxide, oxygen and water; no other substances were considered.

(b) The origin of the water was often assumed, not stated, though it passed up the stem in the xylem. Candidates knew that water was lost from the plant via transpiration and made its exit through the stomata of the leaves. That diffusion occurred, was not always stated. Most answers discussed photosynthesis and oxygen was almost always known to be the waste product of this process. However, it was described in general terms and not at cell level so credit for cell / chloroplast could not be awarded. Respiration was thought by some to occur only at night. It was accurately described as the source of the carbon dioxide in the plant, but again, no cells were involved. Although no other substances were considered this did not limit the award of credit.

BIOLOGY

Paper 5090/22
Theory

Key Message

Candidates should be reminded of the need for responses to be clearly legible. If any changes are necessary there should be a clear cancellation and the new work rewritten in an unused space.

Candidates should also be reminded to read questions carefully before writing their response to avoid any misinterpretation and to establish what is being asked.

General comments

Some of the scripts seen were of the highest quality, but, perhaps more so than in past years, a significant number of candidates gave answers that were scientifically sound yet were not answers to the questions set. This was particularly noticeable in **Questions 6** and **7**.

Comments on Specific Questions

Section A

Question 1

(a) This question was well answered by most candidates. There were candidates who appeared to assume that the tubing referred to was the part labelled 'permeable membrane' rather than the tubing mentioned in the introduction to the question, and thus incorrectly identified it as the cell wall.

(b) The missing vacuole was the most common correct answer.

(c) Although terminology used in a description of osmosis can be confusing, it was not the terminology that caused problems in this question. Water was described as entering both the model and the cell, sugar or 'the solution' was described either as entering or leaving by osmosis, and it was not uncommon to read that the model and the cell would behave differently even though the question clearly suggested that the two would show similarities. Although these were the errors, many candidates gave thorough and accurate accounts of exosmosis and its consequences.

Question 2

(a) Although several candidates suggested 'genes' most opted for DNA.

(b)

(i) The type of cell division mentioned showed a majority in favour of the accurate answer meiosis.

(ii) Although there were several suggestions of implausible numbers, the commonest error was to suggest there would be '23 pairs' of chromosomes.

(c) Most candidates realised that the sex of the person would be female, but then suggested that the reason was that the chromosomes were in the form of an 'X'. It needed to be clear that it was not the appearance of all the chromosomes that was important, but the fact that the sex chromosomes (pair 23) were both X chromosomes.

(d) It was common to read that the person suffered from Down's syndrome and that the candidate appreciated the significance of the extra chromosome 21. References to sickle cell anaemia were the commonest incorrect answer.

(e) The fact that different species have different numbers of chromosomes was generally well known; that such a condition would make gamete formation difficult was less well known.

Question 3

(a) This question was aimed at examining candidates' knowledge of the difference between reflex and voluntary actions. Unfortunately, it was common to see just one letter offered as an answer, suggesting the candidates did not have a clear idea of what was expected, or were insufficiently sure of their knowledge to produce a meaningful response.

(i) The problem here was that candidates did not realise that a reflex action where both receptors and effectors are associated with the eye would not involve the spinal cord, thus **J** made regular erroneous appearances.

(ii) Often **A** (the brain) appeared as the only letter given. Otherwise, there was a misconception that a receptor would be necessary to initiate a voluntary response.

(iii) This part elicited a degree of speculative guessing with very few candidates managing to arrange as many as four of the letters in the correct sequence.

(b) Despite the problems encountered in **(a)** candidates often managed to correctly identify a reflex (involuntary) action and a voluntary one.

(c) All marking points for this question were regularly seen. The only pair that did not appear as frequently were the fact that nervous reactions usually involve muscles whilst hormonal ones tend to affect glands or organs. A general fault was not indicating how the responses differ, but instead, to describe one type and omit to mention the comparative effect.

Question 4

(a) **K** was sometimes identified as an ovule and **L** as a stigma, but full credit was commonly awarded.

(b) Sepals and petals were regularly correctly mentioned.

(c) It was not uncommon to see that pollination and fertilisation were confused, and thus **K** was offered as the site of pollination. A significant number of candidates overlooked the question completely.

(d) The club-shaped rather than feathery stigma and the anthers at the same height as the stigma might have been a large enough clue to this flower being insect-pollinated. However, a slight majority opted for wind-pollinated. It was felt that there was insufficient evidence to suggest that the flower was self or cross-pollinated. Those that opted for the incorrect type of pollination were struggling to find features amongst those not shown to confirm their choice.

Question 5

(a) Peristalsis was the most common answer, but several opted for 'digestion'.

(b) It was clear that most candidates did not realise that fat yields considerably more energy per unit mass than any other form of foodstuff. Carbohydrate was the most common answer.

(c) Weaker candidates appeared not to appreciate the difference between complex and simple molecules, therefore stating that fatty acids rather than fats were digested. There was confusion in the response of some candidates between the role of bile and that of lipase. Candidates were often aware that absorption was the cause of the decrease in **(ii)** however only the most able candidates identified the lacteal or lymph as the destination of fatty acids. There were few references to the origin of the lipase that is involved.

(d) Although there was a general understanding that amino acids are absorbed in the ileum, there were surprisingly few that mentioned that they are absorbed into the blood capillaries. Many then became confused between fat and protein digestion in the ileum and the duodenum, and also often overlooked protein digestion in the duodenum completely, opting for references to further digestion in the stomach. The fact that there is a change of pH in the duodenum, favouring digestion by different proteases was almost universally overlooked.

Section B

Question 6

(a) Unfortunately, the syllabus term 'distribution' was not clearly understood by a very large number of candidates. Thus, instead of explaining why chloroplasts are found in specific positions in plant leaves, candidates gave a detailed and often perfectly accurate account of the part played by chloroplasts in photosynthesis. This often allowed them to be awarded credit for mentioning the reception of high levels of sunlight, but references to precisely where chloroplasts are found were relatively uncommon.

(b) This part was generally well answered, with a mention of the evaporation of water through stomata being responsible for drawing more water (and therefore ions) up to the leaves being seen the least frequently.

(c) Although the question specifically asked for the position of vascular bundles, a very high percentage of candidates wrote only about the function of vascular bundles with reference to the carriage of water and solutes. The fact that vascular bundles contain strengthened xylem for support and are arranged in a circle around a stem to help to support and to resist bending was almost completely overlooked. There was almost no mention of how vascular tissues appear in a root.

Question 7

(a) The question asked for a description of '*how blood is made to flow….(by)…the heart'.* However, as with **Question 6**, the vast majority of candidates did not address the question as set. Instead, they gave an account of the sequence of chambers and blood vessels through which the blood travels as it passes through the heart. The blood was said to pass, move or flow, and when the word 'pump' was used, it was often the only relevant term employed in the answer. Valves had an occasional mention, sometimes followed by a mention of their preventing back-flow, but it was rare indeed to read of the heart undergoing muscular contractions, or that the left ventricle has the thickest muscle to supply the force necessary to send blood at high pressure round the body.

(b) It was clear that a surprisingly large number of candidates had not learnt the difference between arteries and veins, or, perhaps, had not understood the meaning of the term 'lumen', as arteries were often said to have large lumens. However, many knew their arteries well and all marking points were regularly seen.

(c) Those who knew their arteries also knew their veins, though few appreciated the need for valves in veins to be arranged as a series in order that blood could be moved from one set to the next.

Section C

Question 8

(a) This part was well answered by the majority. The most common error was to believe that carbon dioxide is evolved during anaerobic respiration in muscles.

(b) Tracheal structure was well known by some, but others showed a somewhat hazy knowledge. Cilia were often said to manufacture mucus and to 'filter' dust from the air. The trapping of bacteria was not mentioned quite as often as might have been expected.

(c) Candidates were very comfortable with this part of the question. Not mentioning bacteria in **(b)** often caused them to omit reference to the effect of an increased number of bacteria entering the lungs. Nevertheless, there were plenty of references to possible bacterial infections of the respiratory system. It was not always realised that cilia are destroyed by smoking, and thus mucus is not able to be removed by them.

Question 9

(a) It had been intended that the 'biological system' referred to in the question was a food web, though some allowance was made for those who considered the system to be the digestive system. For those who fastened on to the web concept, full credit was often awarded. References to a named foodstuff containing energy, as chemical energy, were the marking points that were least often seen.

(b) A simple mention of respiration breaking down a carbohydrate to release energy was required. References to respiration were less common than might have been expected, and many believed that energy is *manufactured* by metabolic processes.

(c) All marking points were regularly mentioned, but many catabolic rather than anabolic reactions were suggested. It was not that often mentioned that energy is required to maintain body temperature, but generally, this section was well answered.

BIOLOGY

Paper 5090/31

Practical Test

Key Message

Candidates should be prepared to display not only their biological knowledge but also their knowledge and experience of practical work, together with the use and application of practical skills and techniques.

General Comments

The questions tested candidates' abilities to follow instructions, make and record accurate observations using written and drawing skills, to take measurements and perform simple calculations. Candidates appeared to have more than sufficient time to complete the paper.

Comments on Specific Questions

Question 1

(a) When **D1** is held below the surface of hot water in a beaker for about 10 seconds, the best answers described bubbles escaping from the surface through the stomata due to the expansion of air which escaped via the leaf spaces. Weaker answers incorrectly referred to the decolourisation of the leaf with a loss of chlorophyll or that the venation became more distinct.

(b)

(i)(ii) Candidates were asked to repeat the procedure in **(a)** on the leaf samples **D2** and **D3**, cover each with iodine solution for two minutes and tabulate their observations and conclusions. This was well done by the majority of candidates in that **D2** turned blue-black/black and **D3** yellow/brown, indicating that starch was present or absent respectively.

(iii) When **D2** and **D3** were dipped in hot water, the most correct responses suggested that this process softened the tissue or improved penetration of the iodine solution or made the leaf tissue more permeable. Weaker responses again focused on the effects of hot water on removing chlorophyll or in some cases sucrose.

(iv) When asked how the treatment of **D2** and **D3** differed, the majority of candidates correctly referred to light differences and that **D3** must have been covered or kept in the dark. Weaker answers focused on differences in the starch content of **D2** and **D3**, with **D3** being de-starched.

(v) Taking the observations and conclusions given in Table 1.1, most candidates appreciated that no starch remained in **D3** as little or no photosynthesis had taken place, but there was little understanding as to what other processes were involved such as respiration and translocation. Instead these weaker responses again focused on the absence of chlorophyll.

(c) Candidates were asked to outline the stages in the process by which the decolourised discs were prepared. Many candidates correctly stated that the discs had been dipped in boiling water to kill the cells or prevent enzyme activity, or increase permeability followed

by heating in ethanol in a water–bath to remove the chlorophyll. In weaker answers there was frequent repetition relating to the discs being left in darkness resulting in no photosynthesis and also no starch, essentially repeating what had already been stated in **(b)(ii)**

Question 2

(a)

(i) The reducing sugar test was well executed with a correct description of heating the test material for some time in the same volume of Benedict's solution with that of the material containing reducing sugar in a hot water-bath.

(ii) When comparing the relative concentrations of reducing sugar in **D4** and **G**, the majority of candidates described how the rate of change occurred by observing the progressive colour changes from blue to yellow/orange/red, hence confirming that much reducing sugar was present.

(iii) When the test for reducing sugar was carried out, many candidates correctly observed that yellow/orange/red indicated the presence of reducing sugar in both **D4** and **G**.

(iv) The higher reducing sugar content occurred in **D4**, although in the weaker responses **G** was frequently indicated.

(b) In order to improve the investigation to obtain a more reliable result, the best answers stated that repeating / replicating the procedure was necessary plus measuring accurate volumes of the test solution. Weaker answers suggested that heating the solution longer was required or repeating the test described in **(a)(i)** using enzymes.

Question 3

(a)

(i) Most candidates produced a large realistic drawing of **D5** with clean lines and containing a pappus with hairs. Rarely was any structure on the achene shown.

(ii) Calculating the magnification of a drawing by ruling a line on the drawing to show where measurements are made is a standard biological procedure. In most responses, measurements were undertaken accurately and the correct method for calculating magnification was frequently given by dividing the measurement on the drawing by that of the specimen. This was then expressed with an 'X' or 'times' and also including correct units within two decimal places.

(iii) When asked to suggest how the structure of **D5** enabled the seed to be more efficiently dispersed, many candidates correctly made reference to a large surface area or surface area to volume ratio or that the seed contained a pappus / parachute–like structure to assist in wind dispersal. This structure delayed its fall to the ground in order for the seed to be carried further or over a longer distance. Weaker answers commented on the presence of petals instead of a pappus of hairs, with pollen grains being produced or in complete contrast that the seed was dispersed by animals.

BIOLOGY

Paper 5090/32

Practical Test

Key Message

Candidates should be prepared to display not only their biological knowledge but also their knowledge and experience of practical work, together with the use and application of practical skills and techniques.

General Comments

The questions tested candidates' abilities to follow instructions, make and record accurate observations using written and drawing skills, take measurements and perform simple calculations. Candidates appeared to have more than sufficient time to complete the paper.

Comments on Specific Questions

Question 1

Specimens provided: slices of celery (petiole) and potato (tuber)

(a)

(i) Using the hand lens provided candidates were asked to observe the end of the celery slice to which iodine solution was applied and make a large labelled drawing of the structures shown. Many candidates produced clear transverse sections with realistic vascular bundles, which were also correctly labelled, although only the iodine–stained areas were drawn and labelled in the best answers.

(ii) Calculating the magnification of a drawing by ruling a line on the drawing to show where measurements are made is a standard biological procedure. In most responses measurements were undertaken accurately and the correct method for calculating magnification was frequently given by dividing the measurement on the drawing by that of the specimen. This was then expressed with an 'X' or 'times' and also included correct units within two decimal places.

(b)

(i) Candidates were asked to cut the celery (and potato) slices vertically into three pieces and with the help of a diagram to describe where the iodine stained the piece of celery. Many candidates drew transverse rather than vertical sections and were therefore unable to indicate how the iodine had spread down the vascular tissue. The best answers not only produced a suitable simple diagram of a vertical section but also drew streaks of stain down the vascular bundles and in turn spreading down the tissue.

(ii) When asked to compare two ways in which the stained pieces of celery and potato differ, the best answers showed that the staining in the potato was uniform and blue-black/black in colour compared with a regional distribution and yellow/brown in the celery.

(c) Candidates need to improve their understanding of the differences between the structure of celery and potato as shown by the iodine solution. The best answers showed that stored starch turned blue-black / black all over the potato, whereas in the celery little or no storage occurred, with the iodine stain confined to the xylem / vascular bundles. Weaker answers ignored any reference to staining with iodine and candidates simply stated that celery is a stem growing above ground and that the potato is an underground root / tuber.

Question 2

Specimens provided: W1 – white of a hard–boiled egg (no yolk); W2 – fresh or dried coconut flesh

(a)

(i)(ii) The majority of candidates responded well to completing these food tests both in terms of methodology and providing appropriate positive and negative results. With fats, weaker answers omitted to add water after dissolving in ethanol and also incorrectly referred to a white precipitation when concluding a positive result.

(b) There was a most satisfactory response to correctly completing the observations and conclusions in the table provided for both **W1** and **W2**. Exceptions to this were again referring to white precipitates as a positive test for fats or not obtaining a positive result for protein in **W2**, unless this had been highlighted in the Supervisor's report.

(c) The majority of candidates need to improve their understanding of how to investigate why one food material releases more energy than another. The best answers described using forceps whilst igniting suitably named specimens of known mass in a measured volume of water in a test-tube, together with recording initial and final temperatures. This was followed by noting an increase in temperature and the subsequent release of more energy, including the use of the formula in joules / kJ of energy released. Repeating the procedure in the same volume of water was also a valid response. Weaker answers either gave theoretical responses describing the energy content of major food groups and / or what they were capable of releasing. Other weak answers focused on testing food samples such as fats and reducing sugars quoting the variation in the depth of colour obtained as a measure of energy release.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key Messages

This paper tests experience of practical work and the ability to use practical skills such as observation, drawing, data handling, interpretation of results and experimental design. It is important that all the information provided with each question is read thoroughly, including introductory material, such as the details of how an investigation has been carried out. This information may well be necessary for answering the questions that follow.

General comments

The number of marks awarded overall covered most of the range of those available.

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

It appears that candidates had sufficient time to complete the paper.

In general, candidates were more confident in making responses involving knowledge than in application of that knowledge to unfamiliar practical situations.

Comments on specific questions

Question 1

(a) (i) Only a few candidates were able to correctly identify both structures indicated on the photograph of the flower.

(ii) The candidates correctly identifying meiosis as the type of cell division that occurs to produce structure C were in the minority.

(iii) Since many candidates had identified the cell division as mitosis, answers to this part often incorrectly referred to the growth of the plant, or the production of genetically identical offspring.

Some candidates did refer to haploid, diploid etc., but in an incorrect context, thus making it un-creditworthy.

Better candidates correctly identified meiosis and went on to explain the significance of the reduction of chromosome number in gamete formation.

(iv) This question required a line labelled X-X to be drawn horizontally through an anther. A small number of candidates did this correctly. Candidates who drew lines through the ovary, stigma or style could not be credited. A few labelled a petal or did not provide an answer to this part.

(b) (i) The majority of candidates read the question and drew the outline of Fig. 1.2 as requested, although some included unnecessary detail and shading. A small minority drew various parts of the photograph in Fig. 1.1, or only a small portion of Fig. 1.2.

Most drawings were of good size, although sometimes lines were sketchy or incomplete.

Better candidates drew diagrams showing the five areas and the indentations on either side, in good proportion to each other.

(ii) The magnification of their drawing was correctly calculated by a good number of candidates. Better candidates recorded their measurements in the spaces provided and showed each step of the working clearly. Although not asked for in the question, some candidates demonstrated good practice by indicating on the drawing where the measurements had been taken. The correct expression was used to calculate the magnification, sometimes expressed as drawing size over specimen size, or just by using the measurements they had recorded.

The question asked for the magnification of the drawing compared to the actual size of the specimen that was photographed in Fig. 1.2. This meant that the fact that the structure in Fig. 1.2 was magnified 60x should be taken into consideration. Better candidates did this and good final answers were expressed correctly with 'x' or 'times' and no units.

(iii) There were a few candidates who suggested a method of transferring the pollen grains onto the slide. Most referred to the use of a mountant or stain, with some naming a suitable stain. The use of a cover slip and the prevention of air bubbles were also mentioned. A few referred to the removal of any excess stain.

Question 2

(a) (i) Better candidates correctly identified the plant organ shown in Fig. 2.1 as a root. Some candidates incorrectly stated that it was a stem or root hair or vascular bundle.

(ii) The majority of candidates correctly identified the cell type in D as xylem, although a few thought incorrectly that this was phloem.

(b) (i) This question asked candidates to describe the role of xylem in the transport system of a plant. Most candidates stated that xylem carries water but some omitted the fact that mineral salts are also transported. Some indication of the direction of water movement was required to gain maximum marks and the better candidates did this. A few incorrectly referred to the transport of sugars/carbohydrates.

(ii) The majority of candidates correctly indicated that these cells are tubular/hollow or have no cell contents. A significant proportion of candidates referred to the presence of lignin and demonstrated an understanding of its role. Some candidates suggested incorrectly that xylem lacks cell walls, or that water could easily move in and out of these vessels by osmosis.

Question 3

(a) (i) The ability to read the results of an investigation and to present them in a different way was tested by asking for the construction of a graph from the figures in Table 3.1.

Most candidates constructed a graph; only a small number attempted to draw a bar chart instead of a graph.

Most correctly chose the x-axis for the known quantity, month/year, and the y-axis for the quantity being measured, length.

Not all candidates fully labelled the axes, usually omitting units of measurement.

There were those who did not recognise that since there are 12 months in the year, the scale used should reflect this, even though data for each month is not given in the table. Hence many candidates produced non-linear scales e.g. the distance between month 10 in 2005 and month 04 in 2006 was the same as between months 08 and 10 in 2005. Moreover some candidates produced an entirely non-linear scale on the y-axis using the lengths given in Table 3.1, i.e. 90, 98, 118, 136, etc. equidistantly placed on the y-axis. These could not be credited.

Most candidates were able to plot the points accurately and clearly.

If candidates are using a dot (.) rather than a cross (x) for a plotting point, they should ensure that it is still clearly visible when the points are joined up.

Most candidates joined their plots with straight lines as instructed in the question, although some did not use a ruler.

The best graphs took into account both the month and the year on the x-axis, which enabled candidates to draw accurate conclusions in the next part of the question.

(ii) Although the question asked candidates to refer to the graph drawn, it was also possible to answer this question using the information in Table 3.1. Some candidates correctly identified the months – July and August, but did not state which year.

(iii) Again, this question could be answered using the information provided in the table, which many candidates did – some showing their working. A significant number omitted the units in their answer.

(iv) This question asked candidates to interpret the data shown in the graph, and many candidates recognised that growth is continuous, although the rate of growth varies throughout the year. Some candidates quoted data to support these conclusions, identifying periods when growth was particularly fast or slow. A significant number of candidates incorrectly thought that growth was fastest between October and April – a conclusion which is not supported by the data given.

Some candidates referred to 'length' rather than 'growth', which in a few instances led to incorrect statements such as 'the length of the fish decreased'.

(b) (i) This question differentiated well between candidates.

A simple statement that water temperature has a direct influence on body temperature showed that the candidates had read the information provided, thoroughly.

Those who correctly stated that a higher body temperature made the fish more active were often able to relate this to an increase in metabolic rate and some went a step further, relating this to enzyme activity.

The majority however incorrectly stated that a lower water temperature would increase the activity of the fish whereas a higher temperature would slow down its activity, possibly killing the fish, due to the denaturing of enzymes.

(ii) Some had stated previously that the fish grow more in the colder months and used this idea to suggest that there must therefore be more food available at this time whilst others thought that there would be more food when the fish are least active as they are unable to move quickly to catch insects. Neither of these statements could be credited.

Of those that correctly stated that there is more food available in the warmer months, few appreciated that the reason for this is due to the increased availability of food for the insects and the subsequent increase in their reproductive rate.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key Messages

This paper tests experience of practical work and the ability to use practical skills such as observation, drawing, data handling, interpretation of results and experimental design. It is important that all the information provided with each question is read, including introductory material, such as the details of how an investigation has been carried out. That information may well be necessary for answering the questions that follow.

The questions themselves, even if quite short, should be read carefully so that, for example, the correct cells are contrasted or compared.

General Comments

Almost all scripts were legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written. It appears that candidates had sufficient time to complete the paper.

In general, candidates were more confident in making responses involving knowledge than in application of that knowledge to unfamiliar practical situations.

Comments on Specific Questions

Question 1

(a)

(i) The majority of candidates correctly selected the *x*-axis for plotting the given values (temperature) and the *y*-axis for the variable values (depth of foam). Most candidates used linear scales that made use of the whole grid. Many candidates correctly labelled the axes, including units. Most candidates plotted the points correctly. Some candidates did not realise that a line of best fit could be a curve and joined the plotted points with a ruler.

(ii) Many candidates were able to read the two values from their own graphs correctly. It is important that measurements should also include units; these were sometimes omitted so it was not possible to tell on which axes the readings had been taken. Some candidates read the values from the wrong axes – depth being recorded as temperature and vice versa – which could not be credited.

A very few candidates incorrectly constructed bar charts or histograms although a graph was asked for. The answers of a few candidates showed that they did not understand the word ‘optimum’.

(iii) This question asked for an observation and an explanation for that observation. Sometimes the observation was omitted e.g. that no bubbles would have been formed.

Many candidates correctly explained what would have happened to the enzyme - that it would be denatured at 90 ^{o}C - or described how the shape of its active site would have been changed. A few candidates incorrectly referred to the enzyme being killed instead of being denatured and some thought that a higher temperature would lead to a greater reaction, unaware of the effect the temperature would have had on the enzyme.

(b)

(i) Only a few candidates suggested that sand was added to the liver to increase friction in order to help in the breaking down of the liver tissue or cells to release the enzyme.

(ii) Most candidates correctly knew that a glowing, not burning or lighted, splint will rekindle or relight in the presence of oxygen. A few candidates confused the test for oxygen with that for hydrogen.

(c)

(i) Many candidates suggested that the investigation should be repeated but did not say why. Some candidates correctly suggested repeating the investigation at the temperatures around the first optimum obtained and / or using smaller intervals of temperature. However, many candidates did not understand the concept of accuracy.

(ii) This question about the reliability of an investigation proved difficult for many candidates. This may have been because the description of the investigation at the beginning of the question had not been read carefully. Many candidates suggested that the investigation should be repeated but, again, did not say why.

More able candidates suggested various constants that should be maintained e.g. volume or concentration of enzyme solution, volume or concentration of substrate, temperatures at which the samples were maintained, time the reaction ran for or at which the same endpoint was reached and pH.

Some correctly suggested that all enzyme samples should be taken from the same liver and that a better, more reliable, method of measuring the volume of oxygen evolved could be used.

Question 2

(a)

(i) The animal cells were correctly identified more often than the plant cells. The labelling line for **A** clearly pointed to an epidermal cell and for **B** to a guard cell. Mesophyll cells were not visible and stomata are not cells. Even when candidates were unfamiliar with **A** and **B**, they were usually able to identify **C** as a red blood cell and **D** as some sort of white blood cell.

(ii) Some candidates were unaware that epidermal cells do not contain chloroplasts and incorrectly stated their function as photosynthesis. Better candidates referred to their protective function, either from mechanical damage or in preventing water entry or loss.

Many candidates were aware of the part played by guard cells in controlling the size of the stomata and thereby gaseous exchange and / or transpiration.

That red blood cells transport oxygen around the body was known by the majority of candidates but there were those who referred to them transporting food or nutrients as well, which is incorrect. Many correct functions of white blood cells were

described. Sometimes the language used was too unbiological to be credited e.g. 'fighting germs' rather than 'ingesting bacteria'.

(b) This question related to a common practical procedure. Some candidates had either done this themselves or observed it being done and were able to write full descriptions. However, it was obvious that other candidates had not had the expected experience of doing it or of observing it being done.

Some candidates showed little awareness of the size of cells e.g. take a cell and put it on a slide – this is impractical. Other candidates unnecessarily destarched leaves, removed chlorophyll or described experiments related to photosynthesis.

There were a few candidates who appreciated the delicacy of obtaining a tissue sample or an impression of it. More candidates referred to using a microscope slide and adding a mountant or stain. The use of cover slips and prevention of air bubbles were also mentioned. Most candidates recognised that a microscope would be needed to examine these cells – but it is highly unlikely that they would have used an electron microscope, as some stated.

(c)

(i) The majority of candidates read the question and drew cells **C** and **D** as requested. A small minority drew only the nucleus of **D** and the paler area of **C**.

Many drawings were of good size, with clean lines and good shape. In some, however, the lines were very sketchy or incomplete or a great deal of unnecessary heavy shading had been used. Many candidates indicated the thinner area in **C** and the nucleus in **D** well. Labels were asked for, given by many candidates, but omitted by others. Lack of knowledge of these cells was revealed by the central thinner area of **C** being incorrectly identified as a nucleus or the nucleus in **D** as a chloroplast.

(ii) The magnification of their drawings was correctly calculated by many candidates. They recorded the measurements of their drawing and the cell on Fig. 2.2 correctly with units, sometimes on the drawing itself or on Fig. 2.2, more frequently in the space provided for this answer. They also indicated where the measurements had been taken, as asked in the question.

The correct expression was used to calculate the magnification, often expressed as drawing size over actual size or just by using the measurements they had taken.

The question asked for the magnification of their drawing compared to the actual size of cell **D** that was photographed in Fig. 2.2. This meant that the fact that cell **D** was magnified 800 x should be taken into consideration and more able candidates did this. Good final answers were expressed correctly with x or times and no units.

(d) This question demanded close observation of two cells. Many candidates found this question difficult to answer but some were able to correctly identify four differences between the two cells.

A few candidates continued to work with cells **C** and **D**, having not read that they were to observe cells **A** and **D**. As four differences in the appearance of the two cells were asked for, i.e. in observable features, differences in function could not be credited.

Good answers recorded differences in the shape of the cells, the size of the cells, the shape of their nuclei, the comparative size of their nuclei, that **A** was one of many similar cells but **D** was the only one of its kind and that **A** was attached to other cells but **D** separate.