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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

BIOLOGY

GCE Ordinary Level

Paper 5090/01
Multiple Choice

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

General comments

There is plenty of time allowed for the forty questions, so the instruction to “read the question” is always the most important. For example, in **Question 19**, the stem asks for the vessel with the lowest urea concentration. The wording is very carefully scrutinised to try and help candidates to understand clearly what is being asked, but every word is important. Similarly, in **Question 29**, the diagram needs to be studied, since the tadpole is shown to eat the plants labelled 1 and 4, so it is clearly not a carnivore (17% chose option **C**).

Comments on specific questions

These questions proved to present few problems and most candidates managed most of them correctly: **Questions 1**, **5**, **6**, **7**, **10**, **14**, **16**, **20**, **22**, **24**, **27**, **29**, **30**, **31**, **34**, **36** and **39**.

Question 1

A straightforward start – "Which is a collection of tissues?" – label R.

Question 2

Water potential (λ) is becoming better understood. Water will always move down a λ , gradient to the most negative conditions.

Question 3

Carbon dioxide (A) and oxygen (B) move by diffusion and water enters by osmosis. Glucose would move by diffusion if the gut had a higher concentration than the blood, but since all glucose is absorbed, the process must eventually be active as well.

Question 4

A substrate fits the shape of the active site, so the enzyme is the lock and the protein the key.

Question 8

Since enzymes are all proteins, the biuret test will detect them.

Question 9

The stem describes the signs of scurvy. Nutritional deficiencies are usually very well known – as in **Question 10**, which proved very easy.

Question 11

Too many candidates chose option **A**, which is xylem, although **B** was well known.

Question 12

Digging up a plant may damage roots and affect mineral uptake (**B**), but the stem says 'wilting', which will occur if roots are damaged. The stem still transports water (**C**).

Question 13

The valves 1 and 2 must be open when the ventricles are emptying. The increased pressure will have caused the atrio-ventricular valves to close.

Question 15

Urea is made in the liver so it is already in the blood arriving at the kidneys. Kidney cells will be using O_2 and amino acids and releasing CO_2.

Question 17

Anaerobic respiration will release CO_2 and the level X will go down, not up as in **C**.

Question 18

Muscles that tolerate more lactate will allow more anaerobic respiration and so supply more energy, which will allow the athlete to run faster or further, or both.

Question 19

Since the kidneys remove urea from blood, the renal vein (C) has the lowest concentration. The highest would be the hepatic vein (D), so after passing through the heart and lungs, vessels A and B would have similar concentrations, which would be lower than D.

Question 21

Emphysema, (Chronic Obstructive Pulmonary Disease), may be due to alveolar walls breaking, so fewer, larger alveoli will have a smaller surface area. Tar may coat the walls to some extent (option **A**), but its main danger is as a carcinogen, even although it is slowly removed by cilia action.

Question 23

Muscle control, leading to balance, is associated with the cerebellum.

Question 25

The diagram has a label for the sensory neurone. If it is cut, no pain impulses from the bee stinging will reach the central nervous system, so no pain will be felt and there will be no automatic reflex response.

Question 26

The stem specifies bread making. Yeast produces alcohol as well as CO_2, but the alcohol will evaporate immediately, although it contributes to smell of bread baking. The CO_2 expands as the bread is cooked and causes it to rise.

Question 28

Since CO_2 both enters and leaves box B and organic materials leave, it must be the plants, so C must be the herbivores. This question was good at picking out strong candidates.

Question 32

This was well done, with most candidates choosing the key **D**, but **A** was too popular. Animals do not make urea from nitrates, but from deaminated amino acids. Since only plants, not animals, have transaminase enzymes, this is also the reason why option **B** is wrong.

Question 33

Mitosis is a copying process. The daughter cells have the same chromosome complement as the original cell.

Question 35

Sperm deposited on day 10 would still be viable on day 13 when ovulation occurs. Eggs ovulated on day 15 could be fertilised on day 17, so the total fertile period is 7 days (key **C**). Far too many candidates incorrectly chose option **A**.

Question 37

If the man's genotype is I^AI° and his wife's is I^AI^B then possible children are in groups A, B and AB. Candidates choosing option **C**, wrongly assumed the man to be homozygous.

Question 38

The stem states that albinism is recessive, so the albino child must be homozygous. Since both parents have normal phenotypes, they must both be heterozygous. This question also picked out the best candidates.

Question 40

The heterozygous person has a half chance of passing on the dominant allele, so the key is **C**. The person without the disease must be homozygous for the normal condition.

Paper 5090/02

Theory

General comments

Some very good answers were given to all questions in ***Section A*** and full marks were seen for all ***Section B*** questions, though **Question 7** proved especially difficult for a large proportion of candidates; even those who did very well on other questions in the paper. Some candidates attempted both **Question 8 Either** and **Question 8 Or**, in violation of the rubric.

Comments on specific questions

Section A

Question 1

(a)(i)(ii) Though most candidates had little difficulty in identifying the producer, there was sometimes more of a problem in identifying the trophic level to which organisms **A** belonged. Inaccurate answers given appeared, in the main, to be a consequence of failing to understand the term 'trophic level'.

(b) 'Water' and 'oxygen' were the two most common inaccurate answers, otherwise this part was well-understood. The link between the provision of nitrates and the production of proteins allowing for increased plant growth was not regularly mentioned.

(c) A surprisingly large proportion of candidates falsely believed that either the bacteria killed the plants or an increase in bacterial population used oxygen in the water which caused a decrease in the plant population, rather than plants dying and being decomposed by an increasing population of bacteria.

(d) For many, this appeared to be guess-work, though full marks were commonly awarded. Errors were to show the oxygen level falling from time **B** and continuing to rise after time **C**. Some good candidates carelessly did not continue their graphs for the full time period as shown in Fig. 1.1.

Question 2

(a) Although almost all possible combinations of letters were offered, this part posed few problems to those who understood the question.

(b)(i) Much confusion was shown to exist over the terms *stigma, carpel, style.* The distinction between *anther*, and *stamen* posed many problems. Their exact functions were also sometimes only hazily known.

(ii) This was the part where many showed that, at the heart of the problem, lay the common misunderstandings between pollination and seed dispersal. The stigma was often said to enable **H** to be dispersed easily by the wind. Of those who correctly identified **H** as a structure for catching pollen, few thought to say that the large surface area ensured that a maximum amount of pollen would be trapped.

(c) Many failed to read the question carefully and labelled the nucleus in Fig. 2.2 rather than 2.1 as required. Few selected a stigma as the place that a germinating pollen grain would be found; anthers and petals often being labelled.

(d) Although many realised that the nucleus in the pollen grain was a male gamete and would be haploid, a significant number felt that a nucleus from the petal would be a female gamete.

Question 3

(a) A great deal of valuable time was spent by a high proportion of candidates in drawing every cell in the section of the leaf, when the question asked only for one of each and two guard cells. Palisade cells were often shown to be triangular and guard cells were drawn in surface view rather than in section (though this carried no penalty). The cuticle seemed to pose the greatest problem in this question, being shown variously to cover the stoma, to appear under the upper epidermis, to have a cellular structure and to be an extra layer on each individual cell. This was also the structure most likely to be omitted altogether. Guard cells were often drawn in surface view.

(b) It was reassuring that almost all candidates who remembered to answer this part correctly identified the xylem.

(c) Examiners were expecting answers which described an increase in the concentration of water vapour molecules in the atmosphere with a consequent decrease in the concentration gradient leading to a slower rate of evaporation and diffusion of water from the leaf. Many candidates incorrectly stated that there would be *no* evaporation or diffusion or did little more than repeat, in essence, the wording of the question and often became confused with water potentials.

(d) The transparency of epidermal cells allowing light to enter was rarely mentioned, but most made reference to the protective nature of the epidermis. A common failing was to suggest that it is the epidermis, rather than the cuticle, that is waterproof.

Question 4

(a) There were few problems with identifying the white blood cell, though a significant few thought that the blood vessel was an artery rather than a capillary.

(b) The question asked for characteristics of the blood vessel. To say that 'it is one cell thick' is clearly an inaccurate statement. It is the walls that are one cell thick, and candidates must take care that they are saying exactly what they mean.

(c) This part was very pleasingly answered. A few thought that antitoxins rather than antibodies cause the bacteria to clump together, but, otherwise, answers were precise and accurate.

(d) A problem here was the amount of detail attempted by candidates who had not accurately learnt their facts. Accounts therefore, sometimes became muddled. Examiners can only expect candidates to include the amount of detail outlined in the syllabus.

Question 5

(a) Insulin was almost always correctly given and almost as many accurately labelled the pancreas. Glucagon sometimes looked unacceptably like 'glycogen' and Examiners were unable to give credit for pancreatic juice as one product and a constituent of pancreatic juice as the other.

(b) There were few problems here for a large number of candidates. They correctly knew that bacteria are used and that a gene which codes for insulin production is inserted into the bacterial cell. Some, however, incorrectly believed that cells from the pancreas are implanted.

(c) Although a few wild guesses were made, either a general reference to enzymes, or a reference to the specific enzymes used, often secured the mark.

Section B

Question 6

(a) This part was very well answered. Concentration gradients were (almost always) the correct way round, but several unfortunate references to water entering a plant by active transport did appear. There were few mentions of active transport requiring a living cell membrane.

(b) It may be that this question was always going to ensnare those who believe excretion to be the same as egestion, and unsurprisingly, there were quite a few and several confused egestion with ingestion. Full marks were, however, common for this question indicating that many clearly understood the difference between the processes.

(c) This part was the most disappointing of the three, since a large number of candidates consider breathing to be the intake of oxygen and the release of carbon dioxide rather than the inhaling and exhaling of air. Muscles rarely received a mention. Respiration is still though to be a process whereby energy is *produced* rather than *released*.

Question 7

(a) **Question 5** had, no doubt, primed many candidates to believe that this question was associated with genetic engineering. In fact, it aimed at producing a straightforward account of artificial selection. Even those who realised this, still failed to mention important features of artificial selection – such as continuing the selection process through many generations of offspring. Common errors included the belief that 'genes' are crossed or bred; that the breeder selects only one of the parents with the required characteristic and that *all* offspring automatically show the desired characteristic. Rarely was it mentioned that offspring inherit genes from their parents or that offspring show variation due to mutations and different gene combinations. It was far from uncommon for candidates to abandon any reference to sheep and to talk, instead, about goats, cows and even plants.

(b) Those who realised this section related to mutation often did quite well, especially when they went on to refer to the effect of the environment helping to drive the process of variation. Many, however, rather than speaking of how variation can occur, wrote at length about continuous and discontinuous variation, this describing the causes rather than the effects of variation.

Question 8 Either

(a) Although several forgot to mention that enzymes are made by cells, and, occasionally, that they are proteins, most did very well on this part of the question.

(b) Some candidates referred to the fact that enzymes 'work best' in certain pHs or temperatures without actually saying that within those pHs or temperatures, there is an optimum. Only the more able candidates made accurate reference to the change in shape of the active site and to the consequent incompatibility between enzyme and substrate molecules. Commonly, candidates believed that, while 37^{o}C might be the optimum temperature for an enzyme, anything above that brought about destruction, overlooking that the temperature is likely to have to rise to in the region of 60^{o}C before that will happen. Only a few thought to say that denaturation as a result of high temperatures is permanent. Candidates continue to believe that enzymes can be 'killed'.

Question 8 Or

This was the less popular choice by far.

(a) Candidates who attempted the question were either those clear in their minds of the difference between chlorophyll and chloroplast (with the least common reference being to the fact that chlorophyll is a molecule containing magnesium) or those whose biological knowledge was already exposed as unsound. Less able candidates, by confusing the two terms, made it difficult for Examiners to credit accurate points.

(b) Some felt, unwisely, that a description of two experiments, one to show the need for a suitable temperature, and the other to show the need for light, would adequately answer the question. Examiners expected a reference to photosynthesis being an enzyme-controlled process, and that enzymes work faster with increased temperature. Candidates might have also made mention of the fact that, at high temperatures, stomata close, decreasing the rate of photosynthesis. However, some good answers were seen, with accurate references to enzymes, light saturation and to limiting factors being made by several candidates. A common error was to believe that, above a certain light intensity, the rate of photosynthesis does not increase because the *light* becomes a limiting factor. Several candidates failed to score two very simple marks by mentioning the fact that, at least initially, an increase in either factor leads to an increase in the rate of photosynthesis.

Paper 5090/03

Paper 3 – Practical Test

General comments

Candidates would, in many cases, have benefited by applying better examination technique. Thus, they should be guided by the mark allocation that is stated on the paper, follow instructions more carefully, as in providing labels when a labelled drawing is required, and avoid unnecessary repetition. The latter applied especially to **Question 2 (c)** on this paper.

Comments on specific questions

Question 1

(a)(i) A wide range was accepted and because of the nature of the exercise, the Examiners did not insist on a first decimal place being expressed. Some answers were given in mm and this was also acceptable. The majority of answers were within the expected range. A few candidates presented answers that were totally unrealistic, less than 5 cm, for example.

(ii) It was generally realised that binocular vision somehow prevents perception of the blind spot but there was some vagueness in expressing how the different fields of view enable the brain to compensate. Stating that the part of the image that falls on the blind spot of one eye lands on a normal part of the retina of the other eye, tended to be the most rewarding approach.

(b)(i) Some drawings were too small – less than 6 cm across – but most showed the iris and pupil, with some representation of eyelids and lashes. An indication of the structure on the right, the vestigial eyelid, was often omitted, so it was not clear which of the eyes had been drawn.

Pupil and iris were generally labelled, though sometimes confused. The majority also managed one more label.

(ii) There was a great deal of confusion here, with many candidates drawing the pupil larger on the right (one minute after uncovering).

(iii) This did not greatly affect the explanation here because credit was given for stating that the iris controls pupil size by the correctly explained activity of circular and radial muscles in the iris. This should then have been related to the changes in size of the pupil in different light intensities and the effect of controlling entry of light into the eye. The concept of dazzling rarely emerged; there were, instead, vague references to damage and to blindness which were not accepted. Similarly, the idea of the pupil contracting was equally unhelpful.

Question 2

(a) Candidates should have performed, or at least witnessed, the procedure of testing a leaf for starch, on several occasions. But they were by no means clear, in many cases, as to the purpose of each stage.

(i) Apart from acceptably killing the cells or inactivating the enzymes there was confusion with the later treatment in water to soften the brittle leaf, (part iii of this question). Things like killing superficial bacteria were also suggested.

(ii) It was generally realised that this was to remove the chlorophyll but, with two marks allocated for this section candidates should have realised that something more was required, as, in this case, to allow the better observation of the leaf when the test was complete. Some thought that the purpose of this process was to make the leaf brittle, others suggested that it stopped further photosynthesis.

(iii) Softening the leaf was the expected answer; but many suggested the need to remove the alcohol.

(iv) Again, two marks were allocated, for placing the leaves on the tile as instructed, then adding the iodine solution.

(v) The most usual, though not very common error, was to confuse the two leaves, giving the results the wrong way round. Poor practical technique, which did not receive the marks!

(vi) It was generally understood that the leaf that was devoid of starch had been unable to carry out photosynthesis in the absence of carbon dioxide.

(b)(i) Suggestions within the range 32 – 34 were accepted for the reading that had been omitted from the table.

(ii) The graph was generally well drawn. Very few candidates reversed the axes or produced bar graphs. Either a line of best fit – without wiggles! – or ruled connections were accepted.

(c) Many candidates spent a lot of time fruitlessly repeating the stages of the starch test. The particular significance of using a variegated leaf to demonstrate the role of chlorophyll in photosynthesis was either ignored, or not known. A reference to part of the leaf serving as a control was expected, followed by some record of the colour pattern being made, by tracing or drawing. The leaf should then have been decolourised and tested with iodine solution. It should then have been observed that the positive result of the starch test was confined to the areas of the leaf that were previously green. A significant minority suggested masking the leaf before exposure to light while one or two proposed an experiment involving collecting bubbles of oxygen.

Paper 5090/06

Alternative to Practical

General comments

A good range of marks was awarded, from all parts of the paper. There were just a few candidates who carelessly threw marks away by not following instructions, as for instance in presenting unlabelled drawings when labels were required. Despite Examiners continued attempts to encourage practical work by rewarding evidence of experience of this approach, it was evident, notably in **Question 1** and in the final section of **Question 3**, that a practical approach was unfamiliar. One wonders also whether all candidates had access to a 30 cm ruler.

Comments on specific questions

Question 1

(a)(i) A wide margin was allowed for the determination of the blind spot, yet many candidates presented answers that were totally unrealistic, less than 5 cm, for instance. A few measured in inches, which was not acceptable.

(ii) Stereoscopic vision was frequently mentioned but this did not adequately explain how the part of the image falling on the blind spot of one eye would fall on the receptive retina of the other eye and so be seen, the brain producing a complete image, making us unaware of the blind spot.

(b)(i) A significant minority omitted to label Fig. 1.2. Otherwise the most usual error was to transpose the labels, or occasionally to label the cornea as the iris.

(ii) When the eye was first uncovered the pupil should have appeared to be relatively large followed by a quick reduction in its size as the eye responded to the greater intensity of light. Hence the second drawing should have shown a small pupil. The drawings were reversed by many candidates, while a few, unaccountably, drew sections through the eye. The Examiners expected the outer diameter of the iris to be the same in both diagrams so that the size of the pupil could be judged properly.

(iii) Candidates who had the correct idea described contraction and relaxation of the appropriate muscles of the iris as the size of the pupil was controlled. This was often related, quite correctly to the regulation of the light entering the eye. A few mentioned the pupil reflex but only very rarely were the roles of retina and brain mentioned. Hardly anyone referred to ‘dazzling’. A significant number wrongly referred to radical, longitudinal or ciliary muscles. Also, a few candidates thought that the shape of the lens was under the control of this mechanism.

Question 2

(a)(i) A large proportion got this seemingly easy answer wrong, giving, for example, red blood cells, tissue fluid, plasma – and even liver! The concept of tissues should be well known.

(ii)(iii) The instructions for the drawings were simply not followed by a lot of candidates. Thus, two pairs of cells were not drawn. Many drew plant cells, or 'saw' lobed nuclei – answering from theory rather than observation. Some omitted labels altogether, which was very wasteful of easy marks. Cell walls were often labelled, as were nuclei in the drawing of Fig. 2.1. A handful of candidates interpreted the cells as sections of blood vessels, hence labelling muscular wall and lumen.

(b) Table 2.1 was generally well completed, especially in the first part where valid, contrasting features were well set out. Simple contrasts, like size, shape and number, as well as the non-nucleate condition, as opposed to nucleate, served very well. By far the simplest similarities that were usually mentioned were the presence of cytoplasm and cell membrane. The requirement of the features being *visible* should be stressed thus, functional features like antibody production and oxygen transport were invalid.

Question 3

(a)(i) The calculation of mean lengths in order to complete Table 3.1 was not always correct but candidates were allowed to use their own figures to determine the change in mean length, thus minimising the penalty incurred. Even so, there were often mistakes here, especially regarding positive and negative values.

(ii) The majority completed Table 3.2 correctly though a few made mistakes such as completely reversing the readings or, more commonly, confusing S2 and S3, or S1 and S4.

(b) Most candidates were able to suggest at least one valid improvement. An increased range of concentrations of solution, longer, or a greater number of potato slices were favourite answers. Measuring mass rather than length, or using just one (large!) potato were interesting variants.

(c)(i) There were many excellently drawn graphs. The three common faults were, in descending order of frequency, failure to label the axes, plotting the change in mean length on the *x*-axis and drawing neither a line of best fit nor a sequence of *ruled* connections.

(ii) This usually presented no problem apart from reading the scale, which some found confusing. A few had no idea and recorded '0'.