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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
Paper 1 - Multiple Choice

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

General comments

Candidates performed well on questions that largely relied upon recall of knowledge. They were well prepared. Questions needing more thought caused some problems but discriminated well. As ever it is essential that the stem is read carefully. There are few words that are not required and important clues can easily be missed.

Comments on specific questions

Questions 1, **5**, **8**, **9**, **10**, **11**, **15**, **16**, **20**, **21**, **22**, **23**, **26**, **27**, **35**, **37** and **39** proved to the liking of most candidates.

Question 1

Option **B** was popular - chloroplasts are organelles and organs are more complex.

Question 2

The cells in water will show the greatest increase in length.

Question 3

Those who chose option **B** may have missed the word 'absorb' in the stem and confused inside with outside.

Question 4

Osmosis is not a process that uses energy, so option **C** is not acceptable.

Question 6

Some of the better candidates wrongly chose option **B**. The key goes into the lock, as the substrate (starch molecule) goes into the active site on the protein enzyme molecule.

Question 7

Water moves down the water potential gradient, from zero (water) to more concentrated solutions with lower Ψ's. Since the cells are losing water, the surrounding liquid must have a lower Ψ than the cell solution.

Question 10

A two stage question that the best candidates knew well. Lipases hydrolyse fats, so the emulsion test is appropriate.

Question 11

Option **B** was oddly popular. Excess proteins are deaminated and so more urea would be produced (Key **D**). Many hormones are proteinaceous, but generally their synthesis is controlled by negative feedback.

Question 14

Nitrate metabolism is poorly known. The cellulose wall is fully permeable to nitrate ions, so no control is exerted (**B**). It is clear from the stem that there is a water potential gradient, but nitrate ions would simply diffuse out were it not for the cell surface membrane.

Question 15

This question discriminated well. High pressure, so the vessel must be an artery, high oxygen, so it cannot be the pulmonary artery.

Question 16

The characteristic thin red cells, with no nuclei, were clearly identified.

Question 17

The larynx is at the start of the air passage and capillaries are at the end.

Question 18

As CO_2 is released it is absorbed, but as the peas absorb oxygen, the oil drop moves from right to left. So little heat is released but no change is measurable by this apparatus.

Question 21

No response occurs until the brain receives impulses from sense organs.

Question 24

In bright light the iris rapidly constricts as the circular muscles contract.

Question 27

Few candidates correctly understood 'effective vector'. With no wings, the female mosquito would not be a problem to Man. It could lay its eggs anywhere if they could survive there. Mating frequently does not help either - the honey bee mates only once but the queen bee can lay 100 000 eggs.

Question 28

Decomposers and consumers receive sixty-two percent quickly, and a further four percent when the animal dies.

Question 29

The pyramids are of numbers. Few (large) trees are shown in options **A** and **B**. Few top carnivores are shown in the key **A** and options **D**.

Question 30

Decay (option **B**) releases a lot of CO_2 to the atmosphere but *all* production depends upon photosynthesis - Key **D**.

Question 31

The word 'direct' in the stem points to **A** as the key. Fire is more rapid and direct than the respiration by decomposers of rotting grain (option **D**).

Question 33

Curves **A** and **B** show a classic predator/prey relationship, but species **C** is on an exponential decay towards extinction. **D** is steady, although not numerous.

Question 34

The testa is the wall of the seed - Key **C**. Many candidates chose **D** - did they misread the word 'testa' as 'seed'?

Question 35

Curve **Y** must be the tissues that are growing due to photosynthesis; **Z** (the cotyledons) shows a lower mass than ***X*** (the whole seed).

Question 36

Too many candidates chose option **D**, implying that the egg and sperm fuse in the uterus. It is far more likely to occur in the fallopian tube.

Question 39

The children will all be either $I^A I^O$ or $I^B I^O$.

Question 40

If Aa is crossed with Aa, the offspring will in theory be equally AA Aa Aa and aa. Of the four possible genotypes, AA and aa (i.e. half) are homozygous.

Paper 5090/02

Theory

General comments

Some truly excellent work was seen with very high marks being scored on all questions but there was also a significant number of candidates who struggled to produce meaningful responses. A good spread of marks was obtained for each of the questions and thus the Paper, as a whole, discriminated well between candidates of varying abilities.

Comments on specific questions

Question 1

(a) Almost all candidates recognised the plant cell and, apart from the occasional reference to 'cell membrane' or 'chloroplast', they had no problems in supporting their choice.

(b) Failure to read the question cost those candidates who spoke of Fig. 1.2(b) rather than 1.2(a) some marks. Otherwise the effect of osmosis on the cell was well understood.

(c) Most were back on-track here with answers usually correct - with all scientifically accurate ways of expressing hypo- and hypertonicity being accepted.

(d) Only the best candidates realised that solution **B** would occupy region **C**. Most suggested 'air' with 'cell sap', 'starch solution' and 'vacuum' being common alternatives.

Question 2

As is often the case with genetics, some candidates answered the question faultlessly, but others were non-starters. The most disappointing error made by otherwise able candidates was their failure to use the symbols given and even to change symbols for part **(c)**.

(a) A significant number confused phenotype with genotype.

(b) Some candidates did not set out their genetic diagrams in the conventional fashion, often omitting to show the gametes or omitting to label each line of their diagram. In **(ii)**, only the better candidates appreciated that both alleles (and used the word) made an equal contribution.

(c) This was well-answered - sometimes even by candidates who had struggled with **(b)**.

Question 3

(a) Most knew that amylase is the enzyme used in starch digestion, but then sometimes drew diagrams of the 'lock-and-key' action of enzymes rather than show how the enzyme would effect the starch molecule. 'Stomach' and 'pancreas' were fairly common inaccurate suggestions for regions in the alimentary canal where amylase is active, but many correctly cited the buccal cavity and duodenum (or used acceptable alternative wording).

(b) The majority realised that all fats undergo emulsification and almost as many that fats, other than olestra, are digested and absorbed. In **(ii)**, there was confusion between the terms 'absorption;' and 'assimilation' and several who had given 'emulsification' in **(i)** offered it again here.

(c)(d) These sections were good discriminators with the better candidates threading their ways through the possible advantages and disadvantages of not absorbing fat from the gut. Many, however, appeared to forget that olestra is not digested and thus spoke of its possible effects in the bloodstream.

Question 4

(a) This was usually correct, with careful distinction being made between Penicillium and penicillin. A few suggested aspirin, or even insulin as the antibiotic produced.

(b) Though most knew that amino acids are used for growth, there were not as many references to proteins as might have been expected. As ever, there were substantial numbers who believe that energy is 'produced' rather than released during respiration, and, worse still, that it is necessary for respiration.

(c) Some felt that the air was used to move the paddles, but usually the link with air and respiration was made if not always with the oxygen contained in the air. Although many realised that the small holes created a large surface area of gas, it was not uncommon to read that the holes were small to prevent the escape of the bacteria.

(d) Most appreciated that the water jacket would, in some way, be involved with temperature regulation, but few went on to say that the temperature could be maintained at the optimum for antibiotic production.

Question 5

(a) Apart from some who gave a specific hormone, this was usually correct.

(b) Although a wide range of endocrine organs was mentioned, pancreas and adrenals were the most common. Several, however, joined the pancreas on to the 'open' end of the duodenum, or sited it above the stomach. To describe adrenaline as the 'fight, fright or flight' hormone did not give its 'effect on the body' as asked. Similarly, it was not considered sufficient to say that insulin 'controls blood sugar' when it specifically lowers it by the conversion of glucose into glycogen.

(c) Most referred to the fact that small molecules are more easily carried in the blood, but they often omitted to consider the need for them to pass from cells (of endocrine organs) into blood and/or from blood into cells (of the target organs).

Question 6

(a) It is common for candidates to confuse fruit/seed dispersal with pollination, but fewer cases of this were evident this year. Generally, candidates had little difficulty in producing examples of wind- and animal-dispersed fruits or seeds. Occasionally, the relevance of an animal *eating* a succulent fruit was overlooked, but, otherwise, this section was usually very well answered.

(b) Often, the link between water, a suitable temperature and enzymes provided the only marks obtained in this section. There were fairly regular mentions of water softening the testa, but it was rare to read of water being necessary as a solvent, a transport medium, or as an essential constituent of cytoplasm in new cells. Neither was it common to read of the need for a temperature which would sustain an increased rate of respiration or growth.

Question 7

This question required candidates to think carefully and logically, then to produce a thorough answer. Even some otherwise very good candidates were guilty of not so doing.

(a) Although most appreciated that a decrease in humidity meant that the air would contain less water vapour, disappointingly few then said that this would increase the diffusion gradient between the atmosphere and the air spaces in the leaf. Also, the term 'diffusion' was used only in the better answers. It was rarely appreciated that higher temperatures might increase the rate of movement of water molecules and, only occasionally was it stated that in high temperatures, the stomata will close.

(b) References to transpiration helping to cool a plant were quite common, but candidates tended, otherwise, to lose sight of the question which asked for how transpiration is of value to a plant. They mentioned water being carried in the xylem, but did not go on to explain that in this way, water is carried to cells for the maintenance of turgor, to supply mineral ions or for use in photosynthesis.

Question 8

EITHER

This question was generally well-answered by the better candidates. Even the weaker ones found some marks, usually in part **(a)**.

(a) Although all scoring points were made with regularity, there was just about every conceivable incorrect combination of doming/flattening and contracting/relaxing of the diaphragm and external/internal intercostal muscles. Some of the weaker candidates made serious errors involving cause and effect, with the entry of air being responsible for the movement of the diaphragm and the intercostals muscles. References to pressure changes and rib movements were sometimes omitted and it was common to read that (rather than air) 'oxygen is breathed in and carbon dioxide is breathed out'.

(b) Cilia were often seen as filters, much like hairs in the nose. They were also said to 'produce' mucus and, just occasionally, were located in the oesophagus. To read that they sweep mucus, containing trapped dust and bacteria, upwards towards the throat was surprisingly rare.

OR

(a) The majority of candidates who, otherwise, gave an almost perfect explanation of the part played by the skin in homeostasis omitted to say that its specific role is that of temperature regulation. A few were under the erroneous impression that capillaries move towards and away from the skin surface and that they are capable of constriction. More commonly, it was implied that heat is lost from the skin surface only when the body temperature rises above normal.

(b) This section proved to be far more demanding than was expected. Curiously, many continued the theme from **(a)** and attempted to describe the role of the kidneys in temperature regulation. References to kidneys controlling blood content were far from common and it was often difficult to decide from where and into where substances were being 'reabsorbed'. There were few mentions of anything other than water being removed in urine.

Paper 5090/03

Paper 3 – Practical Test

General comments

The specimens that were provided were generally good but in the few cases where problems were reported by Supervisors due allowance was made in the marking. Most of the candidates appear to have had plenty of time to complete the Paper

Comments on specific questions

Question 1

This question depended upon the investigation of an immature fruit, the pod of a pea.

(a) The standard of drawing was very good though a few were less than 7 cm. long which was the size that the Examiners decided was minimal for adequate clarity. Drawings were generally well labelled and constructed of clear, clean lines. The instruction to cut along one edge of the specimen to reveal the seeds without damaging them was intended to suggest that the cut should be made along the side opposite to the placenta. This would have revealed the seeds lying alternately to either side of the placenta, as would have been shown in part **(iii)**. Perhaps some candidates did not understand the word 'adjacent'. The marks were, however, accessible from either interpretation, provided that an accurate drawing was made. Calyx and style were well labelled but pericarp or pod was frequently omitted and, oddly, so was 'seed'. The funicle and its attachments to the seed and to the placenta were well shown but the destinations of the label lines were not always precise; the funicle was frequently labelled placenta.

The calculation of magnification was mostly satisfactory though some candidates did not record the units of measurement, nor did they always give a decimal place when using cm. as opposed to mm. There were a few instances of excessive rounding (16.7 divided by 10.6 = 1.6, = x2). Examiners normally allow, for instance, 1.8 = x2. Similarly some quoted an excessive number of decimal places – more than the two usually accepted. Working was not always, *clearly* shown, nor was the final answer always written on the line provided. Not infrequently the correct final answer was spoilt by being labelled 'x 2.6 cm'.

(b)(i) Despite the clear indication of the need to consider the time factor very few candidates referred to the relatively slow development of the positive reaction. There was sometimes an unacceptable ambiguity in the reference to a 'blue' colour developing. A good starch reaction should be described as blue-black, or black. 'Blue' can be misleading in terms of other food tests.

(ii) Here, candidates were expected to describe the process of decolourising the specimen as if it were a leaf being treated in preparation for the starch test. Thus, heating in ethanol (preferably by means of a water-bath), and subsequent softening in water, would have removed the chlorophyll quite effectively, as the majority of answers suggested. Reference to 'a few drops of ethanol' being used to dissolve out the chlorophyll was not acceptable. Prior treatment of the specimen in darkness, or light, or soaking in water, were not accepted either.

Question 2

This was an exercise in estimation, first by means of a given formula then, preferably, by a sampling method.

(a)(i) Measurement of the leaf, **W2**, presented no problem to the vast majority. There was some laxity in presenting the dimensions in cm. to one decimal place and in stating the surface area of the leaf in mm^2 (or cm^2) – the linear unit, or cm^3 was sometimes given instead. The outline of the leaf was usually drawn clearly on the grid. As an indication of a technique to ensure accuracy Examiners expected the squares that were included in the outline to be ticked, numbered, or even dotted. A significant number of candidates did this – and then rubbed out this evidence!

(ii) Not infrequently this space was either left blank or used to introduce the idea of calculating 75% of some figure; quite inappropriate to this section. The acceptable answers included reference to taking care in drawing the outline or to allowing for partially covered squares to be counted. The final answer for the surface area was, again, sometimes spoilt by lack of, or incorrect units.

(iii) Inclusion in the count of those squares that were at least 50% covered, or taking 50% of all partially
(iv) covered squares were the preferred answers. Some candidates suggested more complicated processes that were not in the required spirit; nor was the deduction of the covered area from an all-inclusive rectangle.

(v) The fact that their estimate in **(i)** was very close to the measured area in **(ii)**, differing only by a stated amount was the simple answer here. It was surprising, in many cases, how a difference of 2 cm^2, or less, was considered to be an inaccurate estimate! Other acceptable references were to the possibly uneven or irregular shape of the specimen affecting the estimation.

(b) It seemed logical to expect that coming after the completion of part **(a)** candidates would apply the same technique for estimating the area of the compound leaf shown in Fig. 2.1. So, a sample of, say, 3 leaflets might have been measured, the mean determined and the mean value multiplied by the number of leaflets. This approach was adopted by some, but variants were common, with some loss of marks. The most frequent of these either involved the measurement of a single leaflet, or measurement of all 15 leaflets followed by summation of the results which was more logical than the determination of the mean at this stage. Sometimes this mean value was given as the final answer. At some stage Examiners looked for adjustment being made for the 75% factor, as in part **(a)**. Reference to the possible effect of the toothed edges of the leaflets was also expected, but very rarely seen.

The use of a superimposed grid gained some credit as did the measurement of the entire leaf though the petiole presented a problem! It was, however, difficult to award marks for the significant minority who described a technique but did not include any supporting figures.

(c)(i) Bubbles of air are frequently seen escaping from a leaf held in hot water, often as a prelude to testing the leaf for starch. Candidates usually had no trouble in making this observation.

(ii) The correct, simple explanation, that air in the intercellular spaces of the leaf expands due to the heat and emerges from the stomata on the lower surface, was given by the majority. A significant number of candidates said that the intercellular spaces expanded! There were also less accurate accounts that involved transpiration and diffusion. Those who failed to observe the bubbles tended to describe colour changes and to suggest the destruction of chlorophyll or enzymes. A number of candidates illustrated their answer to this section by drawing a section of a leaf to show the intercellular spaces. This showed that they had more than adequate time for the Paper!

Paper 5090/06

Alternative to Practical

General comments

In this Paper the intention of the Examiners was, as usual, to reward those candidates who showed by their answers that they had had experience of practical work. Preferably they would have performed tasks similar to those mentioned, or at least observed such procedures. The golden rules of following instructions and being guided by the Syllabus should always be applied. For example, when a large labelled drawing is required it is obviously inadequate to produce a drawing that is unlabelled, yet this continues to happen. And in describing the results of food tests, or similar processes, care should be taken in selecting familiar, acceptable colour designations.

Comments on specific questions

Question 1

Candidates were expected to apply their knowledge of the test for glucose as a reducing sugar together with the information on sucrose that was provided. Using this information they were expected to describe how, stage by stage, they could demonstrate the presence of sucrose as the only sugar in a given solution.

(a)(i) The initial stage in the process was to show that the solution contained no glucose, by describing, in practical terms, how a reducing sugar test on some of the solution would have been negative. For this it was necessary to heat some of the solution with Benedict's solution, with the result that no colour change occurred; the mixed solutions remained blue. Common errors were in not applying heat, or in using biuret reagents.

(ii) The next stage was to describe how the original solution could be hydrolysed, either by heating with dilute hydrochloric acid or by the action of an enzyme at a suitably lower temperature, frequently related to the optimum, or body temperature. There was no need to employ both methods, or a mixture of the two. After the treatment with acid the solution should have been neutralised, or made slightly alkaline, with sodiumhydrogencarbonate. Some candidates made the observation – surely from experience – that the neutralisation process was complete when effervescence ceased.

(iii) Repeating the Benedict's test on this, the hydrolysed solution, would confirm that it now contained reducing sugar which could only have come from the original solution of sucrose! The connection between the presence of reducing sugar in the hydrolysed solution and the presence of sucrose in the original was made only rarely. A number of candidates elected, inexplicably, to add iodine solution at this stage.

Many candidates did not understand the import of this question and their responses were to re-write the information in the bullet points, often in an apparently random order.

(b) By remembering the evidence from section **(a)** candidates were expected to realise that the sucrose molecule is larger than that of glucose. The effects of this are that glucose can be absorbed as such, but sucrose needs to be digested. (Some said that sucrose was larger, without mentioning the term molecule; this was not accepted.) The impression that glucose cannot be absorbed was widespread and many went on to say that it was therefore passed out of the body, or, in some unspecified way, converted to glycogen. Many said that glucose was not absorbed because it could not be digested as no enzyme was present.

Question 2

(a)(i) Most candidates appreciated that the metal gauze was necessary to prevent the leaf litter falling into the beaker although this was expressed in a variety of ways. Others gained the mark by stating that it allowed the animals to fall through although some made the mistake of referring to the gauze as a filter.

(ii) Again, most candidates were aware that the muslin gauze would prevent the animals from entering the tube or being swallowed (sometimes by 'the pooter' which suggests that they thought that the pooter was the person rather than the apparatus) although some believed that it would stop the animals from escaping.

(b)(i) Many candidates named light as a stimulus but some made the mistake of stating it was the light bulb. Fewer mentioned heat (or temperature) and only rarely was humidly seen. There was a variety of other suggestions including smell, food, touch, gravity and the metal gauze. Some candidates completely misunderstood the question and gave totally unrelated answers.

(ii) The way in which the stimuli might be of benefit to the animal was frequently poorly answered and weaker candidates often scored zero on this section. Of the correct responses, the most common were to avoid predators or to find food; some made the comment that animals might go deeper into the litter where it would be cooler, to escape the heat. There were hardly any references to avoiding dehydration.

(iii) Most candidates were able to suggest why the pooter would have an advantage over the use of forceps, giving reasons such as not harming or crushing the animals or providing a quicker or easier way of collecting more specimens. Many gave the reverse argument but some failed to mention that the forceps would cause injury, simply stating that 'it would hurt them'.

(iv) Very few candidates indeed gave correct suggestions as to how the animals could be slowed down (at least without suffering permanent damage, such as asphyxiation or pickling in alcohol!). A small minority suggested the use of tranquillising or anaesthetic gases and a handful correctly stated that the temperature could be lowered. Many said that sucking slowly would have the desired effect.

(c) Generally, the bar charts were well drawn though some suffered from being so faint that the bars were not clearly discernible from the background grid. Some drew accurate bars but neglected to label the *y*-axis and others put the labels for the animals in the wrong position. It might be borne in mind that graphs of whatever sort require names and units (or labels) on both axes – data readily obtained from Table 2.1 in this case. Reassuringly, few reversed the axes. Some lost a mark for not ruling the lines or from shading carelessly. Equally acceptable bar charts were based on the animal column or on the feature column which required total numbers to be determined for each feature.

(d)(i) Many candidates did not appreciate the significance of the line in the pyramid of numbers and then commented that this pyramid had fewer trophic levels than the pyramid of numbers. Good candidates appreciated that there was only one tree but that the tree would have the greatest biomass.

(ii) The vast majority of candidates placed the letters in the appropriate levels. Some did not observe the rubric and wrote names instead of letters.

(e) There were many, varied suggestions as to why the mosquitoes would be found on the tree. A number of candidates felt that they would be sucking the blood of other arboreal inhabitants. The Examiners were looking for recognition that male mosquitoes feed on liquid of plant origin, rather than on blood and that mosquitoes tend to be nocturnal, resting in shady, sheltered places during daylight. Surely these facts are widely studied in connection with the teaching of malaria and its control.

Question 3

On the whole, this question on blood structure and function allowed candidates to accrue marks fairly easily.

(a)(i) Remarkably few candidates correctly named the tissue. Bone marrow, blood plasma and tissue fluid were among the attempts frequently encountered.

(ii) Conversely, almost every candidate recognised cell **A** as being a red blood cell or erythrocyte.

(iii) Most candidates were able to give at least one good reason as to why the edges appeared darker then the middle although there were some vague references to haemoglobin being present at the edges without mentioning that it would be more concentrated. Good candidates quickly achieved full marks for stating that the red blood cell is a biconcave disc without a nucleus. There was, however, frequent reference to the cell 'containing blood'.

(iv) Candidates found this section more difficult and often repeated their response to **(iii)** without linking a particular structure to a specific function. A common mistake was to state that the red blood cell has a larger surface area to carry oxygen rather than to increase its ability to absorb. Better candidates gave excellent responses and obviously clearly understood the significance of adaptations such as large surface area, flat shape, elasticity or haemoglobin content.

(b)(i) Drawings were generally relevant and well executed; however, some candidates neglected to label them or the granulation was not illustrated. There were some references to cell walls and a few misguided attempts to show sub-cellular structures such as mitochondria.

(ii) While measurements were almost always correct, either in centimetres or millimetres – the latter unit is preferred - some candidates then performed the wrong calculation, dividing the width of the cell by that of the drawing. Many gained a mark for reference to the magnification although some were not quite clear as to how to use it. Some omitted the 'x', or 'times' in the answer, gave too many decimal places or attached a unit, usually cm. to the answer, so invalidating it. Commonsense dictates that an answer of less than x1, or of the order of 'x3205.33' is not realistic! A few instances were noted of the two measurements being added together in order to determine the magnification. There were a few instances of excessive rounding (such as 16.7 divided by 10.6 = 1.6, = x2). Examiners normally allow, for instance, 1.8 = x2.