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

General comments

Candidates seemed to find this paper slightly easier than previous years, although it still separated candidates satisfactorily. Their knowledge continues to improve, although there are still areas of the syllabus, such as sexually transmitted diseases, which are less well known.

Choosing a correct response by eliminating the alternatives is a valid method of solving a question and **Question 2** is a good example. The stem has important information and must be read carefully - in **Question 7** it begins “A plant is kept in the dark for two days”. Hence it will be de-starched.

“Read the question” applies throughout – e.g. in **Question 29**.

Comments on specific questions

Questions 1, **8**, **10**, **11**, **12**, **13**, **16**, **21**, **25**, **26**, **27**, **31**, **34**, **36**, **38** and **40** mainly required knowledge and most candidates found them straightforward.

Question 1

A friendly start as usual.

Question 2

Option **B** is clearly diffusion, as is **C**. **D** is driven by evaporation, so **A** must be the key. Glucose is absorbed even from very low concentrations.

Question 3

Graphs present a problem to some candidates. If the sucrose concentration is zero, then the tissue will absorb water, so the graph starts at a high value. As the sucrose concentration is increased, less water will be absorbed, so the graph falls. Only **B** can be correct.

Question 4

To hydrolyse the starch, the enzyme must be active. Amylase in **B** will be inhibited and denatured in **C**.

Question 5

Oxygen production will stop at sunset, which must be **D**, and start at **B**, which is dawn.

Question 6

In a graph question, consider the *x*-axis to be zero and then decide what happens as the value increases, remembering that photosynthesis depends upon enzymes and high temperatures will denature them.

Question 7

The diagram shows an alkali, which absorbs CO_2, so no photosynthesis will occur in **R**. **Q** is in the dark, so both starch tests will be negative.

Question 9

Acids from bacteria will have low pH's. Salivary amylase (option **B**) hydrolyses starch and the product is maltose, not an acid.

Question 14

CO_2, does increase as blood passes through the liver, but *X* is the hepatic portal vein.

Question 15

This is Harvey's classic demonstration. The finger at **W** allows blood to be squashed along, out of the vein, from right to left, towards the heart. The valves in the vein – e.g. at **Y** stop blood from returning to the emptied section. The bandage is used to hold back blood in the hand and dilate veins for the time of the demonstration.

Question 17

Muscle contraction clearly requires energy. Digestion requires energy for peristalsis and also for the synthesis and secretion of enzymes. Brain activities - option **D** - require energy too - not only for nerve impulses but also for the action of effectors - muscles and hormones.

Question 18

There was an odd response to this question. Exercise will increase both depth of breathing (from 0.5 dm^3 at rest to perhaps 1.2 dm^3 or more depending on the athlete) and also breathing rate (from about 16 breaths per minute at rest to 60 or more at times). Option **B** was far too popular and may have been misread.

Question 19

Dialysis fluid has little protein. The salt concentration is "correct" and so excess salts in blood will diffuse out during dialysis. Urea concentration in dialysis fluid is zero. The glucose concentration is "correct", so the blood glucose content remains the same during dialysis.

Question 20

Heat loss is achieved when the skin capillaries dilate. More sweat is secreted and evaporates, so less urine will be formed.

Question 22

As light intensity increases, the pupil gets smaller, so the same amount light reaches the retina. Option **A** (and **C**) show the pupil getting bigger. **D** (the key) is steeper than **B**.

Question 23

Antibiotics are used to kill bacteria. The malarial parasite is not affected.

Question 24

The question asks for a conclusion from the information on the graph. Whilst **A** may be true, only **D** may correctly be deduced from the information given

Question 28

The key, **A**, is clearly correct and **B** is clearly wrong. Option **C** has some value, since some carbohydrate is stored, but it is not energy that has flowed through the food chain. Similarly, much of the energy will have powered metabolism (option **D**) but by no means all of it. Most energy is lost as heat or may not even be absorbed by the organism and so passes to the decomposers, which do lose their energy as heat - rotting material can be very hot.

Question 29

A single plant must be in pyramid **X**. Its biomass must be big to supply many herbivores.

Question 30

The flow of organic materials is a way of answering this complex question. Organic materials (from photosynthesis) flow from **B**, so **B** must be plants. **A** receives materials from **B**, **C** and **D**, so **A** must be decomposers. Hence **C** must be the herbivores and **D** the carnivores.

Question 32

D was well known, but a surprising number of candidates are unaware of the damaging ecological effects of deforestation and chose option **B**.

Question 33

This is just knowledge, but less well known that expected. The stem states that the diagram shows a fruit, so the outer wall must be the pericarp, with a seed in it, so the darker layer is the seed wall - the testa.

Question 35

Candidates are expected to know the term "reduction division" by which the chromosome number is halved. Pollen and ovules have half the chromosome number, so the key must be **A**. They fuse together to give the seed, which has the normal chromosome number restored. Option **C** refers to asexual reproduction of the plant, in which the chromosome number is maintained.

Question 37

Natural selection includes options **A** and **D**. **C** is an example of biological control - based on a natural process, but it is not a selection process. Selecting the parent bull and cow is clearly artificial.

Question 39

If male **B** is heterozygous, then mating with the white female **A** would expect some white offspring. Crossing female **C** with male **D** does produce both types of offspring, so **C** must be heterozygous.

Paper 5090/02

Theory

General comments

The marks obtained by candidates in this paper were spread over a wide range, but, significantly, there were some scripts of very high quality. From the mid-range of marks, however, it was clear that some candidates did not think carefully enough about exactly what the question was asking before embarking on their answers. It was also noticeable that, just occasionally, some candidates had become confused with information which was not required by the syllabus.

Comments on specific questions

Section A

Question 1

(a) Bone J was usually correctly identified, though some referred, with insufficient accuracy, to 'shoulder bone', while a very few, somewhat surprisingly, suggested pelvic girdle.

(b) This posed no problems for the more able, but it was not uncommon for candidates who had correctly identified bone J then not to include it in the shoulder joint.

(c)(i) There were a number of answers which referred to ball and socket joint and to all-round movement, but generally candidates were able to state or describe accurately the type of movement found in the elbow joint.

(ii) This was poorly-answered. 'Hinge joint' and 'ligament' were often suggested, and of those who accurately spoke of tendons, few could explain their importance in transmitting force to the bone as the triceps contracts. There was rarely any appreciation that the tendons operate only when the forearm is being straightened.

Question 2

(a)(b)(c) These were well-answered but there were occasional references to growth rather than to photosynthesis in **(c)** - or no reference at all to the *importance* of the conditions in Jar L.

(d) This part was generally answered correctly, though some incorrectly believed that, after the application of iodine solution to a starchless leaf, the leaf will be white.

(e) Most answers mentioned that the substance in Jar M had absorbed the carbon dioxide, but omitted to mention that the plant is continuously releasing the gas through respiration. The respiration factor was again quite often overlooked in Jar N.

Question 3

(a) Usually only the position of the hypothalamus caused any real problems with almost every part of the brain being suggested as its possible location.

(b) Many candidates failed to appreciate that this section was asking for 'how hormones travel from the brain to the reproductive organs'. Many spoke only of the effects of the hormone - which was the information sought in the next part of the question.

(c) Help was provided in the question to steer candidates towards a valid answer, but even so, many were unable to suggest that the child might show enhanced growth or early puberty. Many mistakenly believed that the question was about the effects of thyroxine.

Question 4

Although the style of this question was different from the more usual format, many candidates produced faultless answers. In **(a)**, a few, not reading that the question asked for a 'chemical reaction', simply gave the one word 'glycogen'. Only candidates who struggled to perform well on the paper as a whole were unable to offer a suitable nitrogenous excretory product or to offer two correct elements.

Question 5

(a)(b) A few candidates transposed plumule and radicle and also cotyledon and testa. In **(b)** some surprisingly suggested 'endosperm' - a term not required in the syllabus.

(c) Despite the statement in the first line of the question and two further mentions of the process, a proportion of candidates failed to appreciate that this section related to the *early stages* of the germination of a *seed*. Instead, they assumed that the graph showed the sugar in the plumule of a seedling which was photosynthesising. References, therefore, to enzymes (amylase) digesting stored starch, and the subsequent transport of the sugar produced were relatively rare.

Section B

Question 6

(a) This question was very well-answered by many candidates. There were regular references to the transport of water and mineral salts as well as accurate mention of xylem structure and how it is suited both to this purpose as well as for support. The very narrow nature of the vessels and the importance of this for capillarity was often overlooked as was, in particular, the arrangement of xylem in vascular bundles around the stem to withstand bending forces caused by wind.

(b) This part, on the other hand, attracted answers that were often superficial and inaccurate. Starch and sugars were often said to be 'stored' in the xylem. Glucose was often inaccurately identified as the translocated sugar and rarely was there any mention of the importance to the insect of the sucrose and amino acids ingested. Only a very few candidates appreciated that the nearness of the phloem to the outside of the stem, and the relative softness of the phloem walls aided the insect in its quest for food.

Question 7

(a) The significance of the words 'continuous' and 'clean' was lost on an extremely high percentage of candidates. Those who did realise that these words were central to a good answer seemed unaware of what was expected of them. Examiners were looking for references to hairs (*not* 'cilia') in the nose for filtering dust from the passing air. They were then expecting reference to cilia in the trachea sweeping up mucus together with the dust it had trapped, and certainly not to cilia filtering the air or trapping the dirt. Candidates were also expected to describe the action of muscles and the effect of pressure changes in maintaining a flow of air, but instead, many described alveolar structure and the diffusion of oxygen into the blood. Some took a wider view and spoke of plants taking in carbon dioxide and releasing oxygen or they described problems of pollution.

(b) This section produced better answers with candidates describing the effect of reduced oxygen availability on the rate and depth of breathing. A few missed the important fact that climbing a mountain represents relatively vigorous exercise, but a pleasing number followed their arguments through to the production of lactic acid and increased amounts of carbon dioxide. Weaker answers progressed no further than to mention that 'faster breathing rates cause more oxygen to be taken in'.

Question 8

Either

(a) The general principle was understood, of protein from a dead animal being decomposed by bacteria and then nitrogen-containing ions being absorbed by plants and re-built into proteins before being eaten by a herbivore. However, detail was often omitted. Rarely was there any mention of the progressive breakdown - via amino acids - of protein during decomposition. There was rarely any mention of the need for herbivores to digest ingested protein before it can be assimilated. Some candidates opted for the unnecessarily complex route via denitrification, but such answers were able to score full marks if correct.

(b) Full marks could be scored here for reference to a named bacterial process in the nitrogen cycle and the fact that these bacteria release carbon dioxide through respiration. The term respiration was often forgotten and it was disappointing to see the number of answers which suggested that 'carbon' is released into the atmosphere.

Question 8

Or

(a) Those candidates who had learnt the distinction between the terms 'gene' and 'allele' quickly registered full marks for the section, but, clearly, this is an area where candidates are seriously confused and, as a result, find great difficulty in writing sentences which convey any valid biological information.

(b) Many were comfortable giving a specific example which, though not the intention of the question, was still able to pick up enough points to score a maximum for the section. Again, however, much was written by some candidates which made little biological sense. The commonest incorrect belief being that environmental changes *cause* genetic changes and that an organism is able to adapt itself to its environment. Candidates believing this rarely referred to gene mutation leading to great *variety* amongst members of a species with a very few of the variations having survival value. It was also commonly believed that the survival of an organism immediately produces a new species - the time factor almost always being overlooked.

Paper 5090/03

Paper 3 – Practical Test

General comments

Candidates were much more comfortable with the familiar exercise in **Question 2** than with the more innovative **Question 1**. There was welcome evidence of good preparation in examination technique from a lot of Centres.

Comments on specific questions

Question 1

The question concerned the perception of heat stimuli in a variety of circumstances.

(a)(i) The construction of a neat, well ruled and fully enclosed table was required; the table was then used to record the candidate's observations. The expected result was that the fingertips should have detected the warmest feeling, the inside of the arm the lowest. In fact, the reverse was frequently perceived. A common approach among those who did not fully appreciate the problem was to reiterate the bullet points in an apparently unrelated sequence.

(ii) An explanation in terms of the greater sensitivity of the fingertips (or other area, depending on the previous answer), due to a higher frequency of perceptors (or nerve endings) was expected, but was rarely given. The usual responses referred to the thickness of the skin, or epidermis, the relative area of skin that was in contact with the surface of the test-tube or something to do with the blood supply.

(iii) This required candidates to pick out relevant items from the introductory paragraph to **(a)**. Such items included the use of the water bath to ensure controlled heating, checking the temperature inside the test-tube with the thermometer and tentatively touching the test-tube against a suitable area of the skin. Some justification might have been suggested for each action.

(b)(i) Surprisingly a significant number of candidates recorded for the hot water a temperature that was outside the prescribed range! Some also claimed to have achieved improbably low temperatures.

(ii) The correct responses were usually described in a variety of ways, with only a few suggesting a converse effect.

(iii) The explanation here was often some way from suggesting a comparative effect between the final perception and the earlier experience of the perceptors. There were many references to heat flow, or exchange between the fingers and the water. The fingers were said to become numb in some cases. The results were commonly repeated, with no attempt at explanation.

(iv) The concept of a control was required here, either stated or described. Many answers referred only too vaguely to greater accuracy or reliability without mentioning the word 'control'.

(c) Surprisingly, many candidates did not identify the 'other part of the body' and gave nothing more than a recapitulation of the question. Use of the toes was the expected approach; some bathed or showered the whole body, or moved from room to room, while others drank water at appropriate temperatures – though usually without stating which body part was involved in the perceptions. Not uncommonly a quite different approach was attempted, suggesting other temperatures or time spans. These ideas were not accepted.

(d) Experience generally dictated that babies needed to be protected from a bath that was too hot, while the hazard for the elderly was the danger of catching a chill in water that was too cool. Relatively few answers drew on the experience of the earlier part of the question, especially in **(b)(ii)**, to appreciate the unreliability of a subjective, finger-dipping preparation for bathing a vulnerable patient.

Question 2

This was a familiar exercise in the observation and recording of the structure of fruits and seeds, together with some food tests.

(a)(i) There were plenty of differences to list in the table and most candidates wisely chose three simple, contrasting pairs of features, such as the number and the size of the seeds, dryness or succulence of the fruit, the shape of the fruit or some reference to loculi or placentation. A large proportion of the answers were in the form of correct pairs of features. Marks were lost, however, by the frequent references to differences in colour, despite the rubric of the question. Nor were features concerned with methods of seed dispersal relevant. Also, switches between the two specimens sometimes occurred part way through the question.

(ii) Candidates might have been more aware of the need to make their drawings sufficiently large that they comfortably occupied most of the space that was provided; 5-6 cm was a good size and it was decided that 4 cm was the minimum acceptable diameter. The focal point of the drawings should have been the hilum, shown from different aspects in the two drawings and the labelling should have concentrated on this feature as well as the testa and the micropyle. A few chose to draw the entire pod, or both specimens S1 and S2.

(iii) Determination of the magnification of their drawing was generally well done with only a few candidates spoiling their answer by including a unit such as '$\times$ 3.4 cm'. Similarly there were very few instances of candidates quoting an excessive (more than 2) number of decimal places – read from their calculator – or of rounding up or down by more than, say, 0.2. Thus, $\times$ 3 was not accepted when the calculation resulted in the figure 2.58, as was indeed noticed.

(iv) In contrast with the drawings in **(ii)** the intent here should have been to concentrate on the internal features of the seed in which all parts of the embryo were revealed, after the two halves of the seed had been separated. Observation of the plumule especially, even with the hand lens that was provided, were frequently lacking in accuracy, both of the structure that should have been revealed and its situation between the cotyledons. It was commonly supposed that the term embryo was synonymous with plumule, or combined radicle and plumule. Yet again there were examples of candidates submitting drawings that were completely unlabelled.

(b)(i) Different Centres reported variation in the responses of the pericarps of the two fruit to the starch test and the Examiners were grateful for their guidance. In general, if the descriptions gave black, or blue-black as opposed to no change, yellow, brown, or 'the colour of iodine (solution)', they were given credit. 'Nothing happened' was not an acceptable response, however.

(ii) The biuret test was well known but in many cases a more adequate preparation such as cutting up or crushing the material should have been included to show how, in practice, the test would have been performed. A number of candidates knew of the biuret reagents but then spoiled their answers by naming them wrongly. Heating was occasionally, and wrongly, included; there was some confusion with other tests, as to the colour of the products and, most surprisingly, some examples of the use of Millon's reagent, which disappeared from the syllabus many years ago.

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 and by the mark allocation on the question paper, 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. Nor is it sensible to use either time or space on repeating the question as part of the answer, as a number of candidates did.

Comments on specific questions

Question 1

(a)(i) The majority of candidates correctly drew the arrow, pointing to the left, on Fig. 1.1.

(ii) Marks were readily obtained by reference to the xylem and to leaf structure. There were a few incorrect references to phloem. Mention of roots and root hairs was not relevant in describing what took place in the cut stem and details of physiological mechanisms were not required either. Rather oddly, a significant minority thought that water enters the stomata and then proceeds down the xylem.

(b)(i) Graphs were generally of a good size in the grid provided and were usually a curve of best fit, or the points were joined by ruled lines, both of which were acceptable. The axes were sometimes inadequately labelled and numbered, some with non-linear scales. Plots were not always clear; generally crosses were satisfactory but dots were often too small (a few were too big!), and not sufficiently visible to be checked as they were not ringed.

(ii) Satisfactory in most cases though some described, or attempted to explain, shape of curve rather than uptake of water. Some did not refer to the peak at noon; others described only until noon.

(iii) Most candidates readily picked out two features from light, humidity, temperature and wind.

(c) The main error here was to describe the effect of air movement on transpiration rate, with no attempt being made to show how the apparatus could be used in an investigation – especially one in which a control was used, or some attempt made to eliminate, or limit, other relevant factors. Successful answers referred to the use of a fan, operating at different speeds, or at a range of distances from the plant, compared with a control in still air. Distance moved by the bubble in a set time was the criterion of comparison.

Question 2

(a)(i) Most candidates managed to draw something reasonably like the shape of the artery and vein but many were influenced by the darkness of the reproduction of the photomicrograph and shaded excessively, often untidily. Observation was poor in most cases; the partial separation of the outer wall of the artery and the wavy appearance of its lining layer were very rarely recorded. Labelling was usually poor as well. In many cases the drawings were left completely unlabelled, or the artery and vein were not labelled. By far the most successful label was the lumen of each of them though some thought that the lumen was the wall of the vessel. A minority of candidates thought that the structures in Fig. 2.1 were cells.

(ii) Apart from those who measured Fig. 2.1, rather than the components on Fig. 2.2, this section was well answered, with units of measurement being given and the final magnification well expressed. There were, however, some examples of the familiar faults such as rounding up (or down) to too great an extent (more than 0.2), presenting more than two places of decimals, multiplying an otherwise correct expression by x100 (as though calculating a percentage), or introducing cm or mm into the answer, like ‘x 2.4 cm.’. It would have been sensible if more candidates had indicated exactly where they were measuring. Many candidates appeared to be quite unaware that answers that were ridiculously high (several thousands), or low, (less than 1), could not possibly be correct.

(iii) It is pleasing to note that the vast majority of answers were presented in valid, matching pairs of observations. A few, however, concerned properties that were not visible, such as blood pressure, oxygenation, or direction of flow, and hence were invalid. The Examiners also noted some difficulty in being fair to those who transposed, either totally, or, worse, partially, their lists of observations.

Question 3

(a)(i) Well done by most, though fruit juice 3 caused some concern over the positioning of the decimal point and many gave 0% which was not sensible since there had been a change in colour.

(ii) The idea of preparing a set of results of a standard Benedict's test on a known range of glucose concentrations did not occur to many candidates. Such results could then have been used in comparison with the test results on the fruit juices. Some answers were no more than descriptions of the test; others referred to some kind of reference chart while another group invoked the use of chromatography. However, a few made sensible attempts to describe a method of weighing the precipitate but those who attempted to use tools such as 'Clinistix' achieved little success.

(iii) Apart from a few who mistook the name of the Benedict's reagent, this section was well answered with most mentioning the use of a water bath for heating the reagents.

(iv) Most appreciated that insulin – a hormone rather than an enzyme, as stated by a few – caused the conversion of glucose to glycogen and hence its removal from the blood – though not from the body! Thus, a negative result was obtained but those who described this as involving a change to yellow should have realised that this could not possibly be correct. Glycogen was occasionally confused with glucagon and it was sometimes not easy to distinguish which of the two was intended.