O Level

Biology

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BIOLOGY

ORDINARY LEVEL

Subject 5090

Paper 5090/1

General Comments

The candidates generally appeared to have had difficulty in selecting facts appropriate to the question and indeed to be precise in the terms that they used. Examiners were unanimous in stating that there was considerable variation between centres, and that this appeared to be related to the teaching received. Many excellent papers, both in knowledge and technique, contrasted with others from Centres where candidates had neither the knowledge nor the understanding to attempt an examination of this type.

Section 1

Question 1

(a) The food classes required were carbohydrate, protein and fat but starch and sugar appeared frequently. It should be stated that starch digestion begins in the buccal cavity and not in the mouth, as is popularly believed. The mouth is the opening of the alimentary canal through which food passes. The region for fat breakdown was variously given as intestine, large intestine and 'ilium'. The latter was not acceptable since it is another biological term with a quite different meaning.

(b) The word 'enzymes' hardly occurred here. The terms **insoluble** and **soluble** were not often seen and yet they are both vital parts of any definition.

(c) This part was correctly answered by most candidates.

(d) There was considerable variation in answers including the use of 'ilium'.

Question 2

(a) and *(b)* demonstrated the usual confusion which candidates experience between the action of ciliary muscles and the muscles of the iris, so that lines were drawn in every possible position from the cornea to the eyelids. The examiners asked for a minimum of two lines in each drawing, i.e. two concentric lines in **A** and two radial lines in **B**.

(c) (i) Peristalsis as a term was well known but the explanation proved more difficult. Correct details of contraction/relaxation of circular, radial and longitudinal muscles was very confused.

(ii) There was great confusion here particularly with the persistent idea that blood vessels are 'pulled nearer the surface of the skin' or vice versa. Contraction and constriction were confused, and these statements were common: 'capillaries are still contracting', 'vasoconstriction stops all blood flowing' and so on. In many scripts the reverse comparison was expressed i.e. 'vasodilation stops heat loss' and 'vasoconstriction aids heat loss'.

Question 3

(a) Straightforward recall was required here but a great variety of labels were given. The word 'sporangiophore' does not appear to have been taught but 'aerial hypha' was acceptable.

(b) (i) The examiners expected correct answers for **D** and **E** before proceeding to part (ii) which proved surprisingly difficult. Statements such as '*Mucor* absorbs starch' indicated a basic misunderstanding. 'External digestion, secretion of enzymes and the change from starch to maltose' were the points required.

(c) Well known, but many candidates were not given credit for 'a sexual' which seemed to indicate some indecision on their part.

Question 4

This was designed to be a searching question and the examiners were pleased to see so many candidates able to unravel the pathways, the examples and the correct letters.

(g) (iii) was the only answer requiring more than one response i.e. **C**, **D** and **E** and few candidates saw this, in spite of the injunction in italics just above part *(a)*.

Question 5

The examiners endeavour to give candidates every possible chance of scoring a biologically correct answer and there were eleven agreed alternative wordings for *(a)*, seventeen for *(b)* and eight for *(c)* but even so many candidates were unable to score any marks!

(a) The time factor distracted many, but simple comments such as 'to control weeds', 'allow aeration', 'aid drainage', and so on would have sufficed. Expression so often hampered candidates, 'to allow the soil to air' could not really be considered.

(b) 'Provide humus', 'improve water retention', 'release salts' and many other variations were acceptable answers.

(c) 'Flocculate' was trotted out by many candidates and was clearly correct although subsequent elaboration showed that they often did not understand its meaning. The spelling of flocculate frequently left much to be desired but as long as it was recognisable the candidate gained credit. Any reference to pH change, disease control and aeration, in whatever guise, gained a mark.

(d) Candidates could not differentiate between 'seedlings' and 'seeds' so that many candidates mentioned 'germination' and 'water requirement'. This was given no credit for it implied a basic misunderstanding of this process. Very few candidates saw the importance of 'preventing wilting', 'aiding growth' and so on.

Question 6

(a) The two answers to this part were usually correct showing that although these were non-standard graphs candidates were able to read them with confidence.

(b) (i) The main error was a statement that the enzymes were 'killed' or 'died'! This idea that *enzymes are alive* must be eliminated during teaching.

(ii) Many candidates stated correctly that the 'rate increased' but those candidates who referred to the 'time decreasing' received equal credit.

(c) This was well done by most candidates, as was section *(d)*.

(e) This provided a great variety of answers. The 'killing' error appeared again but many thought that on return to 40 °C the enzyme somehow came back to life and started working again. There were several correct points that could be made here such as 'denaturing of the enzyme, coagulation of the substrate, thus no breakdown of substrate', and the fact that 'pepsin works *best* in an acid environment', or better still, that 'pepsin has an optimum pH in acid conditions'. Very few related the pH of 7.0 with this latter point.

Section 2

Question 7

This compulsory question showed that increasing numbers of candidates have little ability to apply general concepts to their learning and bring together various aspects of the syllabus. The examiners were looking for a general description of growth in terms of mass increase, cell increase etc. and reference to where growth occurs in plants and animals. Thus reference to root and shoot apices, germination, auxins, differentiation, effects of temperature/light etc. as well as, in animals, to overall growth, metamorphosis, thyroxine, dietary control, repair, would have all gained marks. The mark scheme allowed also for a comparative table-like approach often used to high-light the differences between animals and plants, e.g. continuous growth v. growth to adult and so on. Candidates instead wrote, in great detail, on the life cycles of plants and animals including frogs, birds and mammals. Marks were eventually gained by accident in the process of rambling dissertations which were often too long and time wasting. Candidates must stick to the given time suggested of fifteen minutes per question.

Question 8

This aspect of ecology is specifically requested in the syllabus, and indeed examples are given, but unfortunately candidates seem ill-prepared for this type of question.

(a) Producers were described as 'plants' instead of 'green plants', consumers were better described but the concept of biological equilibrium was poorly understood. The latter often had 'the balance of nature' without any clear explanation of the relation between producers and consumers.

Considerable benefit had been worked into the mark scheme for candidates who could write in terms of the energy trapping capacity of the green plant and the flow of this energy to other living organisms via the feeding of heterotrophs. This concept simply did not appear.

(b) The example of the action of Man ranged from fantasy to absurdity. Long descriptions of 'wolves in Scotland eating deer' in the twentieth century were only outdone by 'factories tearing down trees'. It seems regrettable that the great majority of these candidates who will never again study Biology go away with such a distorted view of the world's ecological problems.

Question 9

This question discriminated well on a basic biological topic. Diagrams were not of a high standard, not in an artistic sense, which was not required, but simply in terms of accuracy in the drawing of chromosomes and chromatids. There was much confusion in each of the two processes of mitosis and meiosis of exactly how many chromosomes were present at the beginning of each process.

Question 10

(a), *(d)* and *(e)* were the favourite choices, whereas *(c)* was seldom chosen.

(a) Many thought that urea had some importance in this answer. Few mentioned the comparative aspect of this situation, which was that *more* water was lost through sweating and therefore *more* water was reabsorbed through the kidneys. Very occasionally the term *osmoregulation* appeared.

(b) There was some reference by candidates to spores but little information about their germination. The humidity of a closed bin and the lack of air movement was seldom recognised.

(c) There was little recognition that bacteria are parasites, live in organisms and produce toxins as a result of their metabolism.

(d) Some very amusing answers here, although the candidates often obtained marks at the end of a complicated statement. Few recognised that spiracles are only on the abdomen and thorax. Many revelled in the concept of insects opening their mouths under water but were quite happy because they had no lungs!

(e) The candidates who did best on this section probably had done some Physics. Few mentioned the fact that air emerging is warmer and moister and as a result condenses in the cold air. Some candidates thought that the visible particles were due to freezing of the water droplets.

Question 11

(a) The definition required was in terms of, 'a directional growth response towards or away from a unidirectional stimulus', but what was presented was usually in terms of, 'tropism is a movement to a stimulus such as light'.

(b) Answers to this question probably exhibited most of the mistakes encountered by teachers of children learning Biology. Shoots/plumules/radicles/roots were rarely mentioned but when they were they were placed in the wrong part of the plant or the wrong position in the experiment. Candidates were asked to *describe* experiments and controls and the general fault was extreme vagueness. 'Plants' instead of specific structures reacted to light or gravity. 'Cotton wool' or 'blotting paper' were used but never moistened, and so on.

Because different parts of plants respond in different ways, the precise part, and

the precise reaction for each part of the plant must be known by candidates. Time is an important factor in these growth responses and must be within reasonable limits, hours rather than days or days rather than weeks. Diagrams well done gained marks when annotated correctly.

Question 12

Candidates did not answer the question and therefore lost marks because they had *not* correctly identified phenotypes and genotypes *together* with their specific examples e.g.

Phenotypes	night blind	normal	1 mark
Genotypes	**Bb**	**bb**	1 mark
	and so on		

In a genetics question of this type, about specific numbers of offspring, candidates are given credit for relating theoretical results to actual results, e.g. theoretical results give 50/50 or 1:1 ratios but a 3:2 ratio accords with this in terms of the small numbers involved.

(b) There were two possible matings in this section, although many candidates only gave one. The two required gave different numbers of offspring and therefore the possible genotypes and phenotypes varied. Thus **Bb** X **Bb** and **Bb** X **BB** gave different results.

Paper 5090/3

General Comments

The practical examination on this occasion was very straightforward and relied on the execution of relatively simple drawings, familiar food tests and, in question 2, on observations, best done with a hand lens, and comparisons of observed features. Reliance upon purely theoretical knowledge was perhaps less profitable than has sometimes been the case. Question 1 yielded high marks, with numerous candidates scoring the full 20, but marks for question 2 were comparatively low, showing candidates' inabilities to cope properly with less familiar tasks.

Question 1

(a) The question clearly instructed that labelled drawings should be made and two drawings were expected. The drawings should have been not less than 6 cm in length, clear and clean lined (sharp pencil!) and showing such structural features as the hilum and the bulge of the radicle. Basic labelling was expected; testa, or seed coat, hilum or attachment scar, outline of radicle, and micropyle – about the position of which relative to hilum and radicle there was great variety of opinion. In *(b)* (i) most candidates observed the plumule but without noting its detailed leafy form, easily discernible with a lens, as was the scar of attachment of the removed cotyledon, as a moment's thought would have indicated. The labelling required was radicle, plumule and cotyledon.

In *(b)* (ii) the tabulation of functions of the three regions was needed. This was related to the labels given by the candidate in part (i) in that we looked for the function of the structure that was drawn rather than for theoretical recall of the main names.

(c) The food tests proved very easy for the more able candidates but some pitfalls remain and new ones appeared. With emphasis on the biuret test for protein, to the almost total exclusion of the Millon's test, there was a tendency for confusion between the use of Benedict's solution and the biuret reagents. A number of candidates confused heating of biuret with adding sodium hydroxide or copper

sulphate to Benedict's reagent – probably without materially affecting the outcome in either case.

The 'treatment' column implied that practical details were expected; *heating* Benedict's obviously, and mixing or shaking in the case of the iodine and biuret tests respectively. The range of colours was quite alarming. For the starch test, black or blue/black when quantities were present, for reducing sugars (we allowed only glucose as alternative naming here) we looked for consistency, with the solution remaining blue showing no reducing sugar, or turning slightly green indicating the presence of small amounts of reducing sugars. 'No change' and 'nothing happens' are not acceptable observations and no credit was given for treatments, observations or deductions if the treatment was inappropriate, e.g. Benedict's not heated. The colour of the positive biuret test may have been mauve, lilac, violet or purple, and for Millon's, which we did in fact allow, red, pink or brown. It would be helpful for teachers to standardise on biuret reagent as requested in the syllabus.

Question 2

A woodlouse was the subject of descriptions, from the dorsal aspect and from the side. The term *dorsal* was not universally familiar and the descriptions given were generally imprecise and showed lack of observation. Most candidates saw the segmented structure of the specimen, many noted the antennae (a fair number called them feelers, unacceptable at this level), fewer recorded the cerci (we did not expect the term), the small head, the protruding legs and overall oval shape. From the side, the specimens were clearly rounded above and flattened below so that ventral structures were enclosed. This related to the function of squeezing into crevices (many said burrowing) and water retention – rarely mentioned.

(b) The drawing of the leg need not have been complex; we looked for 5–7 component segments, the distal ones being bristly on one side, and the whole neatly drawn. Because of the flexed joints the length and magnification became hard to ascertain consistently, so due allowance was made. The functions and reasons were not clearly separable so credit was given for a reference to locomotion being facilitated by the joints, and the ability to climb, grip onto surfaces or burrow being associated with the bristles or terminal claw. The possible sensory function of the bristles was accepted as an alternative.

(c) Expected **similarities** were: reference to the joints, the visible skeleton, hooks/claws and the smaller distal parts. **Differences**, which should have been expressed as three contrasting pairs, included: exoskeleton/endoskeleton; chitin/bone; hinge joints only/hinge as well as ball and socket; bristly/smooth; linear/pentadactyl.

Paper 5090/6

General Comments

It was again evident, from marking the scripts, that those candidates who had practical experience were better able to cope with the questions than those who appeared to be giving purely theoretical answers. In question 4 the practical skill of making a biological drawing was examined and, in common with Paper 3 the use of a well sharpened pencil was essential, but by no means universal.

Question 1

This question examined candidates' ability to understand an experiment, involving respiration, in which carbon dioxide was absorbed in order that the changing oxygen status could be measured. A control was incorporated, as was also a calculation, the precise requirements of which eluded the great majority.

Part *(a)* Biologists should be familiar with the use of potassium hydroxide (KOH) to absorb carbon dioxide yet it was frequently stated that KOH absorbed oxygen, or, indeed, evolved oxygen. Part (ii) required the corollary that removing carbon dioxide as it was evolved would render the absorption of oxygen more apparent.

The term *control* was well known for *(b)* (i) but was occasionally referred to as a controlled experiment, and the idea of the beads in tube **B** replacing the seeds was generally adequately explained, in terms of minimising differences between the two by replacing the peas with a similar volume of inanimate matter.

Part *(c)* revealed once again the inadequacy of biology candidates' knowledge of simple physical phenomena. Few realised how an increase in temperature (not warmth or heat), would cause increased pressure inside tube **B**, or that a reduction in atmospheric pressure would similarly cause the change described.

Despite the introductory warning to take both tubes into account in calculating the amount of oxygen absorbed, most candidates ignored the control. Thus, the change in tube **A** ($60 \times 2 = 120\ mm^3$), should have been modified to allow for the alteration in tube **B** ($10 \times 2 = 20\ mm^3$). The volume absorbed in two hours was $120 + 20 = 140\ mm^3$, hence $70\ mm^3$ in one hour. A common error was to subtract the second value and there were also mistakes in the expression of units.

Part *(e)* Those candidates with the necessary experience correctly suggested maintaining a constant temperature as, for example, in a water bath. Others suggested pressure control or, vaguely, the use of vacuum flasks.

Question 2

(a) The examiners decided to allow either water uptake or transpiration in this section. Both answers were common.

In part *(b)* a statement was required of the loss in mass (16 g), not always correctly calculated, followed by an idea of how the water was lost, or in other words, a definition of transpiration in terms which did not imply that somehow the water is secreted and then evaporated off the leaf – or something almost as crude.

The requisite mass, 2 g, should again have been stated in part *(b)* (ii) with the explanation that photosynthesis and/or growth had occurred, and that there might have been some retention of water in the tissues of the plant.

There was sufficient space in section *(c)* for an attempt to show how the control without a plant contrasted with the experimental container which bore a plant and that all other factors were the same. The word 'control', alone, did not score a mark in this section since, especially in view of its prior use in question 1, it was seen to be a valid test of examination technique in fitting the answer in the space provided.

Question 3

Many candidates should have read more thoroughly the introduction to the question which explained that the leaves were de-starched but still attached to their parent plants at the time the experimental procedures started. Hence there should not have been answers stating that the leaf remained green, or indeed, white, when treated with iodine solution. The nature of both experiments was such that two factors were involved; in **A**, the necessity of both chlorophyll and light, while **B** showed the need for carbon dioxide and light, the light factor being eliminated by the paper mask, and by the cork, respectively. Only regions (ii) and (v) should have given the positive, black colour, all the rest turning brown.

For part *(b)* the regions were brown because they lacked starch owing to deprivation of (i) light, (iii) chlorophyll and (vii) carbon dioxide.

The concept of a control was again required in *(d)* where for each leaf an area was present which received all the requisites for photosynthesis to proceed. When this was expressed as 'normal conditions' it needed to be amplified. Thus there was the green part of **A** which was exposed to light, and the region of **B** which was not covered nor in the atmosphere influenced by the carbon dioxide absorbant.

Part *(e)* was not well answered. Many candidates persisted in referring to the masking of light when, of course, the covering or blockage of the stomata, (which should have been mentioned), prevented adequate uptake of carbon dioxide.

Question 4

The examiners looked for a clear, clean drawing, devoid of shading and at least 6 cm long so that it fitted the space provided. Credit was also given for accurate representation of the four segments of the tarsus and of the four prominent spines.

In *(b)* most candidates described the joints as peg and socket or hinge and, in turn referred to their gripping function in helping locomotion, in *(c)*.

In *(d)*, however it appeared that the alternatives of preventing slipping or deterring predators were too mundane, so many referred to pollen attachment, stridulation or killing prey.

Parts *(e)* and *(f)* received variable treatment, rarely being very well answered, usually through lack of insight or poor observation. The examiners looked for common features, such as the presence of joints, hooks/claws, small(er) distal parts and the fact that each was visibly a skeleton. The differences, which should have been given as three clearly contrasting pairs were: exoskeleton/endoskeleton; made of chitin/bone; spiky/smooth; with hinge joints only/hinge and ball and socket joints (and others, possibly) and in a linear arrangement/unlike the close situation of radius and ulna, side by side.

Despite these criticisms there were a few candidates who scored maximum marks and many more candidates scored high marks than in previous years.

Paper 5090/7

51 Centres entered candidates for the Field-work Project Scheme, the mean entry for each Centre being about 20. It is clear that in about one third of these Centres whole classes were entered, but the majority of entries were from individual students keen to gain this added bonus for the ecological field-work.

The standard of entries was extremely varied. Some of the better examples of submitted sample projects, and top grade projects from visited Centres, displayed very competent research method, initiative in the development of field techniques and often excellent appreciation of the workings of natural ecosystems. One cannot praise these candidates and the patience and interest of their teachers enough. This minority of the projects often deserve further research efforts and merit display at school and perhaps publication in local journals of natural history. If they provide ideas which pupils and teachers might develop further, then school-based research projects or, better still, publication in the School Science Review or Journal of Biological Education might appropriately result. Whilst such excellence is a welcome product of the examination entry (and in part the raison d'être of this scheme) it is also true that the majority of candidates gain greatly by their experience and that their biology is improved thereby. It is thus very sad when what is often a teacher's failure to guide their candidates adequately becomes the cause of poor submitted work. This year, once again, the moderators have marked

down heavily work that was not, as is stated, investigative field-work or which did not display a large proportion of the assessment criteria. The latter should be explained to candidates fully and verbal encouragement given for candidates to carry out first hand investigations.

The following general comments may help teachers to improve the quality of their candidates' work.

In the case of studies of one environment in which the organisms are the main focus a background description of the locality, the soil, the aspect and the physical nature of the site are important. Often the significance of these governing influences is not fully appreciated and certainly not explained. An awareness of the physical factors in an environment should raise questions, in the mind, about such things as the distribution of organisms in space and in the diurnal and seasonal cycles. Hypotheses to account for distributions are often easily tested or at least partially verifiable by observation.

There is an increasing use of colour print photography in projects. There are economic constraints here clearly, but fuzzy close-ups with fixed-focus Instamatics are pretty worthless records. One or two good photographs with crisp definition and scale lines, or metre sticks included, and clear cross reference to site maps or plans are very valuable. The historical value of a well executed site description should not be underestimated either.

Some understanding of sampling theory and the significance of collected numerical data should at least manifest itself in the discussion that follows its presentation, without of course a statistical analysis per se. For example, it is quite clear that most candidates do not know *why* they are using the quadrat as a sample nor do they state why it is necessary to sample more than once. Many projects have lengthy descriptions of *one* soil sample and *one* pit-fall trap. Soil analysis to determine, for example, humus content by loss on ignition, is so easily done with an electronic balance that several samples could be most easily compared and real understanding of the soil environment gained. Similarly a grid of pit-fall traps set out in a meadow will, in a few days of observation, produce enough data on animal species present, their activity and population density, to become immediately and immensely interesting.

The moderators expect discussion to follow data presentations. Too often this is missing and without it the candidates' perceptions of what they have achieved are not presented to the examiners nor are any of the conclusions subsequently made set in their context. Training in this is all part of good science teaching.

It is inevitable that candidates with stronger teaching produce better project work. Teachers should not abdicate a responsibility here, in the belief that to advise on appropriate field methods is to 'help' the candidate. They need that advice and encouragement.

It has been pleasing to see the level of perseverance and the standard of presentation of projects. It is very much to be hoped that schools will build up their library resources to help with accurate species identification rather than vague generalisation. A Biology Department reference section, in the laboratory, is much to be preferred here. It is also to be hoped that fewer book-based natural history descriptions will be submitted. Sometimes these form the bulk of a project, much to its detriment. More first-hand observation of animals and plants and an intelligent and informed discussion of these observations is what is needed.

The Syndicate hope to publish a brief guide to appropriate field methods. This will be available from the Syndicate by January 1985.