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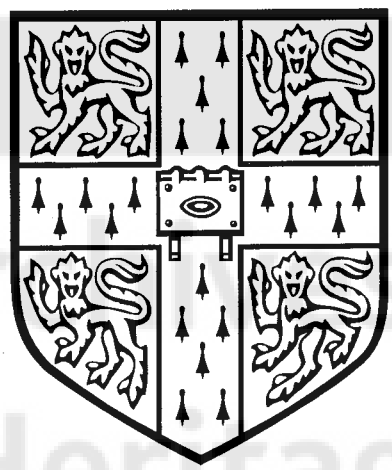

BIOLOGICAL SCIENCES

Report on the June 1994 Examination

BIOLOGY

ADVANCED LEVEL

Subject 9260

Paper 9260/1, 9265/1 Multiple Choice

Proportion choosing each option (correct answers are asterisked)

Question Number	A	B	C	D	*Discrimination (point biserial)*
1	0.17	0.08	0.05	0.70*	0.42
2	0.05	0.85*	0.01	0.10	0.33
3	0.78*	0.07	0.09	0.05	0.38
4	0.05	0.89*	0.02	0.05	0.37
5	0.13	0.46*	0.22	0.19	0.46
6	0.05	0.11	0.07	0.76*	0.44
7	0.29	0.15	0.07	0.49*	0.32
8	0.48*	0.07	0.38	0.07	0.46
9	0.03	0.11	0.78*	0.09	0.41
10	0.79*	0.06	0.07	0.08	0.40
11	0.06	0.07	0.58*	0.30	0.34
12	0.13	0.14	0.20	0.53*	0.41
13	0.07	0.85*	0.03	0.05	0.27
14	0.19	0.11	0.14	0.57*	0.48
15	0.16	0.09	0.34*	0.40	0.33
16	0.14	0.76*	0.56	0.05	0.41
17	0.03	0.10	0.74*	0.14	0.38
18	0.69*	0.09	0.06	0.15	0.33
19	0.04	0.70*	0.15	0.10	0.25
20	0.14	0.07	0.72*	0.07	0.27
21	0.50*	0.29	0.12	0.09	0.44
22	0.72*	0.20	0.04	0.05	0.49
23	0.11	0.11	0.68*	0.10	0.36
24	0.65*	0.11	0.07	0.17	0.29
25	0.25	0.02	0.08	0.65*	0.25
26	0.04	0.09	0.80*	0.07	0.43
27	0.70*	0.06	0.10	0.14	0.38
28	0.16	0.26	0.17	0.40*	0.43
29	0.77*	0.03	0.16	0.03	0.43
30	0.05	0.19	0.04	0.71*	0.31
31	0.15	0.11	0.71*	0.04	0.43
32	0.64*	0.05	0.26	0.05	0.39
33	0.07	0.51*	0.13	0.29	0.51
34	0.71*	0.05	0.09	0.16	0.41
35	0.04	0.09	0.76*	0.12	0.44
36	0.43	0.16	0.33*	0.07	0.25
37	0.24	0.10	0.53*	0.12	0.54
38	0.11	0.58*	0.18	0.14	0.49
39	0.25	0.07	0.08	0.60*	0.40
40	0.72*	0.06	0.03	0.19	0.45

Paper 9260/1, 9265/1 Multiple Choice

General Comments

The mean score for Biology (9260) candidates was 26.12 (65.30%), compared with a mean score of 20.36 (50.90%) for Social Biology (9265) candidates. This represents an improvement for the third year running and is especially marked in Biology. The standard deviation was 7.08 for Biology and 5.86 for Social Biology. Questions answered correctly by more than 80% of Biology candidates were *2, 4, 13* and *26*, while only *Q.13* was answered correctly by more than 80% of Social Biology candidates. Other straightforward questions were *Qs1, 3, 6, 9, 10, 17, 19, 20, 23, 24, 27, 29, 31, 34, 35, 38* and *40*. The most difficult questions, *15* and *36*, were answered correctly by less than 40% of Biology candidates, while less than 40% of Social Biology candidates were able to answer correctly questions *5, 7, 8, 12, 14, 15, 21, 28, 33, 36* and *37*.

Comments on Individual Questions

Q.5 Although the syllabus mentions acid hydrolysis of non-reducing sugars, the majority of candidates did not see its application in a novel context.

Q.7 This was a straightforward question requiring recall, yet more Social Biology candidates chose option **A** than chose the correct answer (**D**). This was also a popular incorrect answer amongst Biologists, suggesting that the effects of enzyme inhibition are not well known.

Q.8 This was a question involving comprehension; candidates were not expected to be able to recall the function of DNA polymerase. Most succeeded in narrowing down the answer to **A** or **C**, but only the more able applied the knowledge that enzymes are named according to their substrates.

Q.11 The most common error was to identify the diagram as metaphase I of meiosis. The question clearly states that two pairs of homologous chromosomes are shown, so the pairs of chromatids shown in the diagram should not have been confused with bivalents.

Q.12 Only the more able had a sufficiently good grasp of the principles of protein synthesis to be able to work out the significance of polyribosomes.

Q.14 There was much guesswork on the part of the candidates in answering this question. None of statements **A**, **B** and **C** is true of the second meiotic division. The fact that the separating chromatids are different is one of the causes of genetic variation amongst the resulting cells.

Q.15 In both groups of candidates, more chose option **D** than the correct answer **C**. The calculation is $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$. Those who gave the answer as 0.25 very likely omitted the probability of the child's being a boy.

Q.16 Many candidates found this an easy question, but of those who got it wrong, over half gave the answer as 1 in 3.

Q.18 Although the syllabus requires knowledge of the mutagenic effect of ionising radiation, it is pleasing that most candidates are aware of the comparable effect of ultraviolet radiation. The majority of those who did not identify the correct option evidently thought the question was about the greenhouse effect and chose option **D**.

Q.21 Most candidates realised that the concentration of CO_2 acceptor would be high, or that the concentration of GP would be low, but many guessed at the concentration of ATP.

Q.22 Many candidates identified the grana or the stroma as the site of carboxylation of RuBP.

Q.25 A common misconception, even amongst some of the more able candidates, is that acetyl-CoA, rather than pyruvate, enters the mitochondria.

Q.28 This was a difficult question but a good discriminator. Candidates should have known that actin and myosin filaments do not contract, but very specific knowledge was required of the identity of the bands. In fact, about half of all candidates chose options **A** or **B**, showing that they did not appreciate the fundamentals of the 'sliding filament' theory.

Q.30 This was largely an interpretation question and was answered correctly by the majority of candidates. The popularity of option **B** (31% of Social Biologists) suggests that these candidates were relying more on their knowledge of the possible effects of high light intensity and high temperature than on the evidence provided by the graph.

Q.32 Option **C** was a popular incorrect response, attracting 33% of Social Biology candidates. This suggests that only the effect on breathing rate of increased carbon dioxide levels was at all well known.

Q.33 This proved to be a difficult question, with more than twice as many Social Biology candidates choosing option **D** than choosing the correct option **(B)**, yet only simple calculations were necessary. Candidates who chose option **D** failed to take into account the volume of air entering the lungs each minute.

Q.36 'Active transport' was understandably a very popular answer, but if lack of ATP *increases* the rate of entry of a solute into a cell, then, the solute must be entering by diffusion and is not being eliminated by active transport.

Q.37 This simple question was surprisingly poorly answered. Only one third of Social Biologists and just over one half of Biologists knew that insulin increases the glucose permeability of cells.

Q.39 Option **A** was popular, but removal of the thyroid gland would cause a decrease in basal metabolism, not an increase. The question was testing knowledge of the feedback control of thyroxine secretion.

Paper 9260/2 Theory (Core)

General Comments

All candidates were able to gain marks on the majority of questions on the paper, the exception being *Q.4*. There is still a small proportion of candidates who are unable to answer genetic questions. Candidates were spread across virtually the whole mark range of the paper, however there were very few excellent scores. Few candidates scored full marks on the free response questions. There was little evidence of planning in the free response questions, with irrelevant information being given in part questions, and generally poor expression of ideas.

Judging by the fullness of the answers to the structured questions, and the lengthy answers to some of the free response questions, the candidates had no difficulty completing the Paper in the time available.

All candidates should be encouraged to organise their answers to free response questions under the appropriate sections. However, it is equally important for candidates to **clearly label** the different sections of their answers to these questions, and to give the correct information in the appropriate section.

The Examiners would appreciate candidates attaching their free response answers loosely with a generous amount of string, or a treasury tag, to the back of the question booklet, and **not in the middle** of the booklet. This would allow the Examiners to turn the pages easily as they mark them.

Comments on Individual Questions

Q.1 This was generally well answered.

(a) A high proportion of candidates was able to correctly identify the missing base as adenine and the replacement base as guanine. However, a number of candidates had difficulty with the spelling of these words, and often 'adenosine' was incorrectly stated instead of adenine. Occasionally, candidates demonstrated their lack of understanding of the fact that affected individuals had the mutant allele, and reversed the two bases in their answer.

(b) Good candidates referred to the change in the single base resulting in a different amino acid being formed, and then went on to explain how this might affect the properties of the protein. Weaker candidates referred to a codon coding for a protein and made no reference to amino acids in their answers. A few candidates referred to the bases being in the actual proteins formed.

(c) A large number of candidates referred to the code as being degenerate and they realised that it was not a frame shift. The weaker candidates stated that a single base substitution would only cause a very small mistake in the protein and as such would have no major effect on protein structure.

(d) Good candidates were able to give clear diagrams showing a channel protein in a cell membrane. They also referred to the hydrophobic regions of both the protein and the phospholipids. However, a significant number indicated a solid transmembrane protein, and they demonstrated their lack of understanding of how proteins are held in the membrane.

Q.2 In this question, a number of candidates did not always read the instructions carefully and, therefore, did not give the desired answers; this applied particularly to *(a)* and *(c)*.

(a) Many candidates described the total changes in pressure and volume, as illustrated in Fig. 2, during the whole of the cardiac cycle. They made no reference to the contracting of the ventricle and, in many instances, figures were not quoted to support the answer.

(b) Good candidates quoted **P** as being atrial systole and **QRS** being ventricular systole. However, there were few good answers to this section. Many candidates split **Q**, **R** and **S**, and referred to three completely different sections of the cardiac cycle, whilst others tried to explain the trace in terms of heart sounds.

(c) There were many good answers with candidates relating the changes in the pressure in the atrium, ventricle and aorta to the opening and closing of the bicuspid and semilunar (aortic) valves. However, through lack of biological understanding, or poor expression, many candidates reversed cause and effect. They stated that the opening/closing of the valves caused the change in pressure in the atrium and ventricle, and not vice versa. Some candidates were very confused and had the blood passing from the ventricle to the atrium.

(d) Many candidates correctly linked the heart sounds with the closing of the bicuspid and aortic valves. Other candidates mentioned the involvement of these valves, but their answers were often wrongly qualified by referring to their opening **and** closing.

Q.3 There were many good answers to this question.

(a) In *(i)*, the majority of candidates realised that as the depth increased, the oxygen production decreased. However, few candidates quoted figures from the graph to support their answer; of those who did, the figures quoted were not always accurate. In *(ii)*, a number of candidates realised that as the depth increased, the light intensity decreases,

and therefore this would be a limiting factor in photosynthesis. Other candidates thought that the decrease in oxygen evolved was related to a lack of carbon dioxide, or to an increase in the rate of respiration at greater depths.

(b) This section caused problems to several candidates. Relatively few were able to explain the relationship between gross primary productivity, respiratory losses and net primary productivity. In *(ii)*, only a few candidates realised that the amount of oxygen evolved was an indication of the balance between respiration and photosynthesis. Many candidates confused respiration and photosynthesis, referring to the uptake of oxygen in photosynthesis.

(c) The vast majority of candidates correctly marked the position of the compensation point on the graph at zero oxygen exchange.

Q.4 The majority of candidates were able to attempt this question, and there were some excellent answers referring to sex linkage and codominance. In *(a)*, the candidates were asked to construct genetic diagrams but not all candidates showed a reciprocal cross. Two crosses were required, one between a black female and a ginger male and one between a black male and a ginger female. Several candidates did not use X and Y chromosomes throughout the question, or only used them in either *(a)* or *(b)*, but not both. It is imperative, in order to gain full marks, that candidates clearly link phenotypes with the appropriate genotypes. A small number of candidates tried to treat the problem as a dihybrid cross, or put alleles on the Y chromosome.

Q.5 For many candidates this was a low scoring question.

(a) A number of candidates correctly related the size of *Littorina mariae* to its short life cycle, to predation by the crabs, or to its genetic make up. Several candidates indicated that only the large *Littorina mariae* were eaten by the crabs and, therefore, all the small ones remained.

(b) The majority of candidates realised that the colour of the shells acted as camouflage against the respective seaweeds and, therefore, they avoided being seen by the crabs. Some candidates referred incorrectly to *Littorina mariae* being yellow and camouflaged against the sand, as opposed to the yellow/brown *Fucus serratus*.

(c) Few candidates scored high marks on this section. Even able students were not able to explain clearly the role of natural selection in maintaining *Littorina mariae* as a separate species from *Littorina obtusata*. Many simply described the features of both species in terms of maturation time, life cycle, size and colour, without any reference to the selective pressures of predation, background and shore position. Some candidates gave generalised answers about speciation, adaptation and divergent evolution.

(d) Most candidates were able to suggest a reason for the absence of *Littorina mariae* from the mid-shore, and the absence of *Littorina obtusata* from the lower shore. The majority of candidates made reference to the lack of camouflage, or to the absence of the correct food source.

Q.6 There were very few excellent answers to this question. A number of candidates appeared to have a vague idea of the methods used to prepare material for the electron microscope, and of how an image of cell ultrastructure is formed by the electron microscope. However, they were not able to describe them accurately, and in sufficient detail, to score high marks.

(a) Candidates frequently outlined the method of tissue sample preparation, but did not explain why each stage in the preparation was necessary. There was confusion about the purpose of fixation and the necessity for heavy metal staining. Relatively few candidates referred to the cutting of thin sections using an ultramicrotome, or to the mounting of the sections on a copper grid. Weak candidates often gave a general account of the preparation

of material for examination under a light microscope.

(b) Few candidates were able to give details of image formation by the electron microscope. Many made no reference to the beam of electrons in a vacuum, focusing using electromagnetic/electric coils, or to the need for a fluorescent screen/photographic plate.

(c) The majority of the candidates scored highly on this section, being able to discuss the advantages and disadvantages of transmission electron microscopy compared to light microscopy. However, many candidates did not make a clear distinction between *resolution* and *magnification.*

Q.7 This was the most popular free response question. There were some excellent answers, but many candidates did not read the instructions carefully and, therefore, did not give the appropriate answer in the correct section, thereby losing marks.

(a) Candidates were asked to outline the main features of the kidney nephron, giving structural details of the regions of ultrafiltration and selective absorption. Some candidates only referred to the main regions of the nephron. Other candidates scored highly giving reference to the fenestrations in the capillary lining, the basement membrane and the podocytes in the region of ultrafiltration, and referring also to the microvilli and numerous mitochondria in the proximal convoluted tubule. Very few candidates made reference to the tight junctions between the cells in the proximal convoluted tubule.

In addition to the structural details, many candidates wrote irrelevant detailed information concerning the functioning of the nephron. This was a waste of the candidates'time as it received no credit in this section.

(b) Many candidates who had given details concerning the functioning of the nephron in *(a)*, gave very brief accounts in *(b)* and, therefore, gained few marks. Several candidates gave details of the events which take place in the loop of Henle, but did not link them to the increasing osmotic potential gradient in the medulla. A number of candidates referred to reabsorption of water only in the loop of Henle, with no mention of the collecting duct. The majority of candidates were able to describe the role of ADH in the production of a hypertonic urine, but some incorrectly referred to it decreasing the permeability of the distal convoluted tubule and collecting duct to water.

(c) There were few good answers to this section. Several candidates were unable to describe the role of the nephron in regulating the pH of the blood. Others made reference to H^+ and HCO_3^-, but could not explain which were excreted and which were retained when the pH became too high, or too low.

Q.8 There were few good answers to this question.

(a) There were too many vague answers and few candidates appreciated how good quantitative data is collected. Many accounts were lacking in a scientific approach to the use of ecological techniques. On many occasions, candidates did not restrict themselves to appropriate sampling techniques in their named habitat in terms of quadrats, transects, kick sampling, sweep netting etc. They often gave a list of various techniques used for estimating population size and measuring abiotic factors, without any reference to the sites/locations where they would be taking samples.

(b) The majority of candidates made reference to the loss of energy at each stage in the food chain as a result of respiration. There was little or no reference to ideas of the trapping of sunlight by photosynthesis, difficulties of making measurements, and the limit to the number of trophic levels that can be sustained in a pyramid of energy.

Paper 9260/3 Theory (List A Options)

General Comments

The standard was similar to that of recent years,with scripts that spanned most of the mark range. Examiners noted with pleasure that the number of Centres that had taken care instructing their candidates in the interpretation of data from tables and graphs,with appropriate **quantitative** statements, had increased.

A continuing criticism is that the extended free response questions often elicit rambling, ill-constructed answers that merely recapitulate a candidate's notes, rather than answering the actual question asked. Answers of this sort are likely to be penalised for both omitting essential facts and for including irrelevent material, if the latter means the quality of a candidate's scientific expression is poor.

Scores for the different options were closely in agreement for most candidates, though there were clear instances where candidates from a particular Centre seemed to have paid insufficient attention to the syllabus requirements of one option.

Option 1—Diversity of Organisms

This was a very popular option and most candidates were able to demonstrate their abilities in a variety of areas. The two free response questions proved to be equally popular.

Q.1 *(a)* *(i)* Most candidates appreciated the fact that there is greater transmission of light in oceanic than in coastal waters. The better candidates were able to interpret to a greater degree, quoting wavelength/colour/% transmission. Occasionally, attention was drawn to differences in wavelength in one particular water rather than to a comparison. Sometimes there was confusion between *transmission* and *absorption*.

(ii) Oceanic water was usually correctly given. Weaker candidates were not explicit in making the link between light penetration and photosynthesis in the reason for their answer.

(b) Candidates seemed to approach this question believing that brown algae **did** grow deeper then green. Consequently, weaker candidates were hesitant about making a clear statement regarding the hypothesis, although they were able to make some sensible analysis of the data.

(c) While most answers showed sensible *comments* on the pattern of the graphs, pointing out differences, the question had asked for *reasons*, so these answers did not score well. Few answers attributed the similarities and differences to the photosynthetic pigments present in each algal type.

(d) *(i)* The idea of seaweed providing nutrients/fertiliser to the soil was usually well recognised. However, a significant number of candidates suggested that nitrogen or protein was released onto the soil. Few answers mentioned organic matter/ humus/water retention.

(ii) Recognition of algae as being rich in protein was widespread but it was not always appreciated that the algae were higher in protein content. Some candidates considered their lower fat content, while others (often unsucessfully) attempted to explain greater energy efficiency. The vegetarian case was put in a high proportion of answers, whilst observations such as 'algae have no bones' and 'algae are more widespread and more easily caught than fish' were also encountered.

Q.2 *(a)* In estimating sizes, there were some good answers, many of them reasonable, but far too high a proportion were wildly inaccurate. There was some confusion between *nanometres* and *micrometres* and a tendency to answer the three very different questions in terms of the same units.

(b) *(i)* This was usually well answered, although there was sometimes confusion between the *cell wall* (**W**) and *cell membrane* (**X**). Weaker candidates, guessing, suggested epidermis, ectoderm, mesoderm and contractile vacuole.

(ii) Few candidates were prepared to commit themselves beyond 'DNA'. Some offered nucleus or ribosomes.

(c) Most candidates approached the calculation as expected, making the correct division and deriving the correct answer. Some obtained the answer by calibrating their rulers, but the weakest did not attempt the question or produced some very strange answers.

(d) There was generally a disappointing response to this straightforward question.

A—candidates usually gave the correct answer, but 'cotyledon' or 'seed' or 'fruit' were frequently seen.

B—stem or root stem were frequent alternatives.

C—there was some confusion between tap, lateral (correct) and adventitious roots. 'Adventitious' was the most frequent suggestion: these arise from the stem, not from the primary root.

D—root hair was normally given, although the incorrect term 'rhizoid' was often seen.

(e) The table was generally quite successful in guiding candidates to make comparative statements about a particular feature of the two cell types. Most candidates commented sensibly on nucleus, cell wall, DNA, organelle differences. A few of the weaker candidates failed to give cell differences and concentrated on the gross structure of the organisms.

(f) The better candidates explained the principle well, whilst weaker ones showed less understanding, often stating that the nitrates were supplied to the soil. The relationship between the bacteria and the leguminous plant was not appreciated, or perhaps not known.

Q.3 *(a)* *(i)* This question was poorly attempted. Most candidates offered hair and mammary glands. Beyond this, the lists elaborated on external limbs, pentadactyl limbs, post-anal tail, gill slits, nostrils, etc.

(ii) Mention of gas exchange seemed to focus attention on gas-exchange surfaces, so the structure was adequately covered. Quite a number of candidates overlooked ventilation and some of those who did deal with it did not go into sufficient detail.The function of the diaphragm and its contribution to volume and pressure changes in the thoracic cavity was not generally well explained. Few candidates mentioned that ventilation or circulation were responsible for maintaining the concentration gradient and tended to give minute detail of the gas exchange, of haemoglobin and the carriage of oxygen and carbon dioxide around the body.

(iii) Better candidates gave lucid explanations of common ancestor—marine—evolution onto land, but it was rare to see the idea of recapitulation mentioned. Weaker candidates concentrated on the idea that the embryo used them to perform gaseous exchange in the amniotic fluid before birth, or that the gill slits took in oxygen until the fetus could use its lungs to get oxygen from the amniotic fluid.

(b) *(i)* Some excellent labelled diagrams allowed marks to be easily awarded here. Candidates should, however, guard against spending too much time on a diagram in a section worth only four marks. Some marks were lost when internal structures were described; however, openings to these structures can be seen externally and marks were available for these openings or pores. Folklore was not forgotten as 'the clitellum shows how the body has regenerated after an injury' or 'the earthworm only forms sex organs when it needs them' or 'earthworms lead a solitary life, so have to reproduce within themselves'.

(ii) Most candidates introduced this section with a diagram: these were of variable quality. They established the three tissue layers (usually correctly) but found it difficult to develop their answers to give the function and derived tissue of each. Too frequently the candidate homed in on the coelom, and dealt with its advantages, to the exclusion of the others. Having established that the coelom is a fluid-filled cavity, a number of candidates suggested that muscles were attached to it. Even good candidates found it difficult to gain maximum marks in this section.

(iii) This was not well answered. Many candidates tried to apply a 'text book answer' to a question which demanded a little initiative. Those who tackled the question with the right approach generally scored well. Desiccation and support were the most frequently seen ideas. Weaker candidates referred vaguely to predators and to the earthworms preferring to live in soil or water.

Option 2 – Applied Plant Science

Q.1 *(a)* *(i)* This was answered well by most candidates, who realised that comments on overall grain yield should be amplified by reference to features of the ear that determine final yield, i.e. ear population and size. Only the very weakest candidates omitted reference to years.

(ii) This afforded little difficulty if candidates appreciated that the yield represented 40% of the crop, although the calculation proved difficult for some.

(iii) Vague statements about weather/climate failed to score here. Many references were made to cultivation techniques when candidates failed to notice the crop was stated as being grown under uniform conditions of cultivation.

(b) *(i)* The general trends were understood by most, but rarely was a figure quoted, such as maximum yield of 5.7 tonne ha^{-1}.

(ii) As in *(i)*, the better candidates observed general trends and quoted figures from the data provided. Very few noted that the maximum yield may not have been reached for direct drilling.

(c) With the exception of protein/amino acid synthesis, few other nitrogenous materials were mentioned, although the nitrogenous nature of purine/pyrimidine bases or ATP/NAD must be known by many candidates.

(d) Poorly answered. References to decreased labour costs and improved soil structure were adequate but little appreciation was shown of advantages such as improved drainage or reduced soil erosion.

Q.2 *(a)* *(i)* The growth of the strawberry where three rows of ovaries remained was noted, but not extended to an appreciation of the normal growth that would have occurred if the auxin source was elsewhere.

(ii) Sensible suggestions were to remove all or none of the ovaries but, despite the usual connotations of the word *control*, the need for identical experimental conditions was forgotten. Candidates need to think in practical terms when faced with experimental design decisions as in *(iii)*, when the application of auxin after the removal of the ovaries should be an obvious choice.

(b) *(i)* Good answers needed to describe the pattern in terms of *general trends*. Better candidates noted 2 main periods of fall, one being of unripe and one of ripe, harvestable fruit. Too often a day by day diary of data was given, showing little appreciation of the overall pattern. Noting what happened on specific dates does not constitute a trend!

(ii) A correct relationship between IAA concentration and fruit fall was noted by most, while in *(iii)* the advantages of a synthetic auxin preventing early fruit fall were well understood from the link with *(ii)*. Improved setting of fruit seemed unknown.

(c) The majority of candidates gave sensible suggestions for both **A** and **B**.

Q.3 *(a)* *(i)* Fewer candidates chose this question. Many answers were sadly lacking in detail; certainly not reflecting an A level standard. Time was often wasted describing at length the route of water from soil to stem. The transpiration stream idea was understood by most but the overall water potential gradient, through the leaf to the atmosphere, was only mentioned by the best candidates. Very rarely did water *evaporate* from wet cell walls into leaf air spaces, this commonly being confused with the process of water moving out of the leaf. Candidates should appreciate that it is water *vapour* that is leaving the substomatal chamber and *diffusing* into the atmosphere.

(ii) A well annotated diagram here gained several marks by showing the unevenly thickened guard cell walls, the guard cells remaining attached at either end of the open stoma and the change in guard cell shape needed to open the stoma. Detail of guard cell structure in terms of presence and arrangement of microfibrils was lacking. Links with turgor pressure were frequently made but discussion of the mechanisms causing turgor changes were often described in preference to answering the question set.

(iii) Only rarely was any real appreciation shown of the importance of stomatal size as a limiting factor for photosynthesis and yield. There was no awareness of the resistance set up to the passage of carbon dioxide as stomata close, while only superficial knowledge of the effects of water stress on a crop was demonstrated. This was a poorly answered section.

(b) *(i)* This was quite well answered on the whole. Marks were gained easily by describing competition for factors needed by crops and problems during harvesting, if weeds were still present. Very few details of the reproductive strategies of weeds that favour rapid dispersal were given, despite the major contribution this makes to the success of weeds and hence their need for control.

(ii) A high scoring section if several different methods of control were described. Unfortunately, many candidates concentrated on herbicides without qualification. Many marks could have been gained for different herbicides with their particular advantages and disadvantages. Weaker candidates revealed several misconceptions here, from confusion with pesticides to muddled descriptions of run-off leading to eutrophication.

Option 3—Applications of Genetics

Q.1 *(a)* A great variety of answers appeared here, ranging from *'natural chemicals'* to organisms. Many lost marks by stopping short of **killing** the pest.

(b) *(i) & (ii)* *Arises* and *spreads* were often not very well distinguished. The better candidates made the point that mutations for resistance are spontaneous, whilst a few candidates thought that mutations are induced by the insecticide, or that the insect purposely mutates 'in order' to become resistant.

A pleasing number of candidates recognised this as natural selection, with the insecticide as the selective agent. Some seemed to argue in an all-or-nothing way, making the population all resistant overnight, but the better candidates expressed their answers in terms of frequency changes.

(c) Most candidates used the word 'control' (even *'biological control'*!); fewer explained what was being controlled.

(d) A large number of candidates produced separate descriptions of the effects of the two viruses, rather than the **comparison** asked for. Marks were also lost by not making use of the figures provided.

(e) Relatively few candidates noted the instruction to *list*. A variety of different methods was credited, but there were a number of very muddled answers, with candidates often confusing bacterial cells with viruses or ending up putting the gene into the insect larvae. Many made vague references to DNA rather than to the specific gene.

Q.2 *(a) & (b)* The majority of candidates recognised this interaction as epistasis and were able to provide the correct genotypes.

(c) This was done well by many candidates. Some candidates lost marks through ambiguities, particularly with gametes, or through omissions, such as not showing an $F_1 \times F_1$, or from not labelling the various stages. (The recommendations of the Institute of Biology should be followed in producing genetic diagrams.) Genotypes in the F_2 generation were often not related to phenotypes. A few candidates produced a correct F_2 and still got the ratio wrong, insisting that it was a 9:3:3:1 or some other remembered ratio.

(d) This proved to be a testing question, but a pleasing number of candidates talked in terms of colour production and inhibition. However, it was plain that some candidates, even though recognising epistasis, had not thought of how it might come about.

Q.3 *(a)* This was the more popular of the two free response questions. In both sections *(i)* and *(ii)* a number of candidates wasted time and energy by writing about techniques other than AI.

(i) Answers were often skewed in favour of 'advantages'—a dangerous examination technique. Some candidates made the same points (cost; ease of transport) many times, in different ways. The better candidates included some *genetic* advantages and disadvantages rather than just practical ones.

(ii) A number of candidates answered this in terms of IVF, GIFT embryo transplantation and surrogacy. Others thought that AI could solve **female** infertility and discussed conception beyond the menopause. Few distinguished AIH from AID. There was rather too much vague discussion of 'playing God'. A number of candidates also overweighted their answers with tabloid-style considerations of possible eugenic abuses of the technique.

(b) This was answered by candidates from a minority of Centres, but many of those who tackled the question did so very confidently.

(i) Most candidates had a general idea of variance, but some found it difficult to put this clearly into words. A number salvaged marks by the use of sketch graphs, but some did not focus on a quantitative character showing continuous variation.

(ii) Good candidates were able to define and distinguish broad sense and narrow sense heritability. Experiments were sometimes described with a lack of clarity with regard to genetic status: pure-breeding at a number of loci is not the same as 'genetically identical'.

(iii) The general idea of existing variation providing the raw material for artificial selection was apparent in most answers, but many candidates left the Examiner to do the work of disentangling the various points.

Option 4—Growth Development and Reproduction

Q.1 *(a)* *(i)* Good candidates frequently scored maximum marks on this section while average candidates managed three or four points worthy of credit. Weak candidates often failed to score because they were unable to describe the salient features of the growth of the leaves and roots of darnel grass with relevant figures for mean dry mass at specified weeks after sowing. A number of candidates, even quite able ones, assumed the units of time to be days and thus forfeited marks.

(ii) Most candidates recognised that the growth of the flower stem and ear commenced after that of the leaf, appreciating that the supply of nutrients came from the photosynthesis of the leaf. Rare mentions were made of the signal from the leaves initiating flowering.

(b) *(i)* A suitable method for measuring the dry mass of the constituent parts of the darnel grass plants was widely known, though a few Centres had clearly not taught it. Marks were lost by the failure to give essential practical detail. It was generally realised that large numbers of seeds should be used at the outset, and that representative samples should be removed at intervals for measuring their dry mass; stress was sensibly placed on the need for the final dry mass to be constant. Few references were made to the necessity to wash soil off roots, divide the plants into their constituent parts, use an appropriate drying temperature rather than just an oven, and cool in a desiccator before weighing

(ii) Nearly all candidates appreciated that the major disadvantage of the procedure was the killing of the samples used.

(c) *(i)* A number of candidates seemed to have little or no knowledge of photoperiodism and were, therefore, unable to refer to the way daylength affected the flowering process and controlled it.

Candidates who had some knowledge often referred to the critical period of light as a requirement, though they rarely stipulated that it was a critical mimimum requirement, and that what really mattered was that the **dark** period should not be more than a certain length. Phytochromes were mentioned, but there was, not unexpectedly, a considerable confusion about which pigment was converted to which pigment by what wavelength.

The involvement of a possible hormone was commonly mentioned and credited. Surprisingly, very few candidates referred back to the data on the graph to suggest

that the leaves might be important in the perception of the correct photoperiod.

(ii) Very rarely did candidates either know or deduce that light and dark periods are approximately equal at the equator, so the day might never be long enough for the critical photoperiod to be reached for the initiation of flowering. This clearly distinguished the top grade candidates.

Q.2 *(a)* *(i)* Most candidates realised that *gonadotrophins* were hormones that controlled the ovary and testis. The mark was commonly lost by the candidates who referred only to *gonads*.

(ii) Weaker candidates erroneously thought that glycoproteins were proteins conjugated either with glucose or glycogen rather than with carbohydrate.

(iii) The term *neurosecretion* was not understood, except by a few outstanding candidates. Examiners had hoped for the idea that secretion was coming from nerve endings, axons, synapses and motor end plates.

(iv) Hardly any candidates could explain clearly the meaning of the term *portal system* as a blood supply with two sets of capillaries or veins at each end for carrying materials/messengers. This was surprising since the hepatic portal system must have been familiar to most candidates for several years.

(v) Most candidates had difficulty expressing the idea of a regulatory or control mechanism that corrected a deviation back to the norm by virtue of the product that was in excess.

(b) The action of FSH on the ovary and testis was well known by average candidates; they made reference to both gametogenesis and secretion of sex hormones.

(c) Weaker candidates did not understand the term *organelle,* but the better candidates had no difficulty in identifying the ribosomes and Golgi body as the organelles responsible for the synthesis of the glycoprotein LH.

(d) Most candidates were able to extract an answer from the text, but they often spoiled their answer by saying the specific receptors for each hormone were on the target organs, rather than on the cell surface membranes.

(e) Only the best candidates were able to deduce the idea of a cascade or amplification with a small quantity of gonadotrophin triggering a large amount of product.

(f) There were some good answers that connected the higher brain centres to the hypothalamus, the release of GnRH and consequently the release of gonadotrophins. Moderate answers failed to make the links clear.

Q.3 *(a)* This proved the less popular of the two free response questions. Candidates perceive meristems as rather dull, theoretical topics and consequently their knowledge lacks the depth appropriate to A level. Few answers were planned in an orderly fashion to give candidates' information its best setting.

(i) Most candidates scored by making reference to mitosis, (not just cell division) elongation and differentiation. The sites of mitosis were usually correctly stated, but references to different planes of division were rare, as were the mention of the procambial strands, leaf primordia, axillary bud primordia, origin of lateral roots and root hairs.

Some candidates also outlined the elongation of cells and commented on

vacuolation, the action of IAA and the stretching of cell walls.

Explanations as to how xylem vessels become specialised were occasionally full and detailed, but it was remarkable to see how many candidates who knew the structure of mature vessels were unable to comment on the obvious specialised features in terms of lignification of the wall, lack of end walls between the xylem vessels in a file, the absence of living cytoplasm and nuclei and the idea that the vessels were dead.

(ii) Most answers to this section were limited to vague remarks about gene switching. Only the best scripts contained coherent ideas about cell specialisation that related to the gradients of chemicals, environmental triggers, hormones, the position of tissues and the role of the cytoplasm. It had been hoped that some ideas on DNA-binding proteins that were sequence specific might have been included.

(b) Good candidates produced some excellent, well-informed and intelligent answers, while the weaker candidates relied heavily on superficial GCSE-type knowledge of events.

(i) The process of fertilisation in mammals was clearly understood, with a commendable depth of detail of capacitation, the acrosome and the fusion of pronuclei being given. Some candidates failed to state the obvious fact that the haploid gametes fused to give a diploid zygote, while others wasted time on long and almost irrelevant accounts of gametogenesis, copulation and embryonic development. Many candidates also included unhelpful diagrams of sperm and oocyte.

The best candidates gave full accounts of the origin of genetic diversity, concentrating on the details of independent assortment and crossing-over (chiasmata were not penalised for being equated with cross-overs). Relatively few candidates mentioned that X and Y sperm contributed to variation and that the fusion of gametes was random.

(ii) This section proved an excellent discriminator, with only the best candidates homing in on *mutation* in its various guises as the only source of genetic diversity. Weaker candidates were confused, citing meiosis, grafting and the environment as factors leading to genetic diversity in a plant propagated by vegetative means.

Paper 9260/4 Investigative Assignment

Once again it is pleasing to be able to record that the overall standard of the investigative assignments remains high. Several candidates generated excellent and original ideas for investigation and, like last year, there were many high quality assignments based on more conventional and popular themes. Some topics were too open-ended to be appropriate for investigation by A level students, but in general, the weaker studies suggested insufficient effort on the part of the candidate rather than a poor choice of subject matter.

A small number of Centres are still allowing their students to investigate almost identical problems in very similar ways. This is not a sensible practice as it gives little scope for individuals to show any originality in approach, so that mediocre marks are almost inevitable. Candidates are required to work independently, and should be encouraged to choose different aspects of the subject. This applies both to studies involving field work and laboratory work.

More candidates now appear to be aware of the syllabus criteria and follow the recommended format when they write their final report. However, a minority of candidates, some of them clearly academically able, continue to omit one or more of the required sections of their report. This inevitably reduces the

final mark obtained. All Centres should ensure that candidates are aware of the criteria which will be used in the assessment, as well as providing guidance about the form the final report should take.

Some comments on specific criteria are given below. Centres new to the Syllabus should consult previous Chief Examiner Reports which have emphasised other points that characterise good practice.

Assignment titles were often poorly phrased. The title should accurately reflect the scope of the work carried out. Often candidates chose a title which implied that a wider study was to be made than the one actually carried out. For example, the title 'The effects of a sewage outflow on the animals and plants of the River Wey' is not acceptable, when in practice, the investigation was restricted to a survey of the effects of the outflow on invertebrate animals and the flowering plants of the river banks.

Some of the weaker candidates failed to formulate a crisp hypothesis, or else did not properly refine the aims of their study. Such candidates invariably made unnecessary observations or carried out superfluous experiments which added very little to their main objective. A more limited approach might perhaps have allowed them more time to carry out a pilot experiment, set up proper controls and use more replicates for the main study. Thus at the end of the phase of data collection, the candidate would be in a better position to draw more meaningful conclusions.

Many candidates still appear to be unsure about the purpose of an *Introduction* section. The introduction gives the candidate an opportunity to relate the investigation to the List B Option, and to present a brief explanation of the scientific basis of the study. The information included should, however, be immediately relevant to the work to be carried out; a repetition of the aims and methods to be used is unnecessary in this part of the report.

A number of candidates omitted to record full details of their practical procedures, which meant that the work could not be repeated by anyone relying on their account. Descriptions of apparatus used, especially in ecological studies, were often rather poor. Many candidates submitting assignments based on fieldwork also failed to include Grid References and sketch maps of the sites sampled in their methods section. Safety aspects were rarely discussed by the weaker candidates when microbiological investigations were undertaken.

In general, results were well displayed by most candidates, lack of appropriate headings or units on data tables or graphs being the most frequent faults. Computer generated graphics often added to the appearance of a piece of work, but in some instances, insufficient care had been taken to ensure that the graphs included were appropriate. Raw data was usually included in an *Appendix* as required, but sometimes this was difficult to follow. Candidates submitting raw data on the original field recording sheets should ensure that the meaning of each column of figures is absolutely clear.

Some candidates did not plan their work in such a way that their data could be analysed statistically, and consequently any conclusions they drew were largely speculative. Others restricted themselves to vague references to the statistics used. The best studies included at least one fully worked example of the chosen statistical test, together with an explanation of how the test helped in the evaluation of the results. Good candidates also explained the significance of the calculated value of the statistic used, and quoted the critical values from the published table.

Discussion of the results was often the weakest part of the assignment. In general, the discussion tended to be rather uninformative and there is still much room for the improvement in the way this criterion is tackled. Some candidates drew unjustified conclusions or failed to note all the implications of their work; others elaborated about points that were quite unrelated to their investigation. Often there was also a failure to refer back to the hypothesis or aims set out at the beginning of the work.

Discussion of any limitations and sources of error, together with suggestions for modifications to the work in the light of experience, showed an improvement this year, though some candidates still tended to link these aspects too closely together. Marks are not given for excuses for mismanagement, or for vague statements about the need for more data. Nor is credit awarded for modifications that are designed simply to overcome any limitations of the validity of the work, already pointed out. Suggestions for additional experiments completely unrelated to the original investigation are not acceptable either.

Lack of an *Acknowledgements* section is still a frequent omission. It is important that the Examiners are aware of any help received from Supervisors, or others, and candidates should indicate when they have made use of laboratory or fieldwork schedules provided by the Centre or Field Station where the work was carried out.

The majority of candidates now use a word processor to produce their final report and the finished products often look very impressive. However, it was noted that the use of English by many candidates could be improved. Candidates still show a reluctance to use a dictionary or spell checker when proof-reading their work.

Most candidates now securely bind their reports so that the numbered pages rarely get out of order. The practice of placing each sheet separately in a plastic sleeve should, however, be discouraged as this adds unnecessarily to the bulk of the finished report.

Once again, some Centres submitted assignments which lacked the official Coursework Coversheets; in other cases these had not been fully completed. Centres are reminded of the need to check that **fully completed** forms are enclosed with the assignments when these are sent to the Examiner, otherwise valid marking cannot be ensured. Where re-sit candidates are **re-submitting** assignments **with new work added**, this should be clearly stated on the Coversheet.

The individual Centre assessments of the quality of the candidates' work were more reliable this year, which is perhaps to be expected now that the details of the mark scheme have been widely circulated. The Examiners are grateful for these assessments, and for the many helpful comments on the Coursework Coversheets.

Paper 9260/5 Practical Test

General Comments

The overall performance of the candidates seemed to be higher than last year. Most candidates attempted all the questions and no part of the paper proved to be especially inaccessible to many candidates.

Comments on Individual Questions

Q.1 A few Centres commented on the variability of the results obtained by their candidates. This was immaterial since candidates were credited for interpreting their own results, and the marking scheme accommodated all the patterns of variation which Centres experienced. It was necessary for candidates to perform the three manipulations using the respirometer in order to obtain data on which to comment. This proved to be possible in virtually all cases. Marks were given for making the observations demanded, none were given for any particular trends which involved them, hence no candidate was penalised for unexpected results.

In *(a)*, the distance travelled by the marker in each of six consecutive time intervals of one minute was recorded. Candidates were then required to produce a graph of their results. Most did this satisfactorily, although comparatively few treated distance moved cumulatively.

In *(c)(i)*, marks were lost by failing to state that oxygen uptake by the seedling caused a pressure/volume reduction in the system and hence a proportional movement of the manometer fluid.

In *(c)(ii)*, a substantial number of candidates thought that removal of the testa had an effect by increasing the surface area of the seedling. This was not credited. Most candidates performed the calculation in *(c)(iii)* correctly; *(c)(iv)* and *(v)* were also well-answered.

In *(d)(ii)*, few candidates perceived that the information indicated the extent to which movement in *(a)* could be attributed to oxygen uptake by the bean, that the data could be used to compensate, and that movement might be due to variations in temperature, to the presence of the soda lime, or might be a capillarity effect.

A common error in *(e)(ii)* was the idea that oxygen uptake occurred and was followed by carbon dioxide solution. Very few candidates commented appropriately on **rates** of uptake and evolution. Even fewer related these to the nature of the respiratory substrate. In *(f)*, many failed to identify any of the points which were credited: the difficulty in controlling the manometer fluid; the possible microclimate changes in the air in the syringe, or the susceptibility of the apparatus to changes in external temperature.

Q.2 The drawings in *(a)(i)* were not of a high quality in most cases. The familiarity of the material for most candidates, seemed to elicit text book responses, rather than drawing what could be seen. Having been instructed to draw cells which illustrated the process of division, it was curious that some candidates drew four cells which did not show chromosomes. There were many erroneous details, taken from theory, such as presence of centrioles, highly stylised paired chromatids and complete spindles. It was easy to reward those candidates who had observed the material carefully and recorded what they had seen. The annotations in *(a)(ii)* were generally better than the quality of the drawings. There was, however, a tendency to quote from 'theory' again, which bore little relevance to what was visible in their drawings.

(b)(i) was done very badly. Having been directed to the region of the slide where sperm could be observed, and told that they could be identified by their obvious 'tails', it was expected that candidates might observe that which was attached to the tail, and to identify it as being a head. This proved to be beyond almost all candidates. Drawings presented bore little resemblance to the rod-shaped structures with a tapering end that were present. *(b)(ii)*, which was related, also yielded few correct answers despite an extensive range being credited. However, the mark total for *(b)(i)* and *(ii)* was low—just two marks, so that little penalty ensued. *(b)(iii)* could be answered from background knowledge and clearly was, because most gained a mark.

Q.3 *(a)(i)* was well-answered, as was *(ii)* which posed few demands, although a small number of candidates did not quote the units in which measurements were made. In *(a)(iii)*, most stated or described peristalsis, but very few commented on the different kinds of movements which this arrangement makes possible. *(a)(iv)* was well-answered.

In *(b)(i)*, Examiners credited drawings which showed columnar shapes, presence of a brush border (shown approximately, e.g. as a zone) and some detail of the nucleus. Few candidates scored full marks. Many candidates answered *(b)(ii)* and *(iii)* perfectly.

There were three main types of responses in *(c)*: some did not understand the question—the idea of statistical significance was obviously not familiar to them, a further group went for a Chi-squared test, and the remainder correctly suggested a t-test.

Paper 9260/9 Teacher Assessed Practical

General Comments

The Moderators were pleased to report that in most cases the general quality of practical exercises set by Centres was of an appropriate standard for A level. However, it is of continuing concern that a minority of Centres had not ensured that the two exercises used to give the final score for a candidate, for a particular skill, had covered the whole skill descriptor, as stated in the syllabus, and this led to degrees of Centre scaling. This situation could be improved for many Centres by more care being taken with the administration of the work. All Centres receive a report on the Teacher Assessed Practical, which contains Centre-specific comments. These should be acted upon if necessary, in order to bring about any improvement required.

The Moderation team moderates both Biology and Social Biology practical work, with the same standards being applied to both syllabuses, although this did not necessarily mean that the same adjustments were made for both syllabuses within a given Centre. Internal moderation is expected within each syllabus, but not between the syllabuses. The Moderators were pleased to see more evidence of internal moderation this year, but there remain a significant number of Centres which supply no evidence of internal moderation, and even no evidence of teachers'marks on any of the work submitted. For a Centre with large numbers of candidates and a number of teaching groups it should be possible to agree on the mark schemes for each practical being used for assessment. Also, it is preferable to use a few common, or very similar, practical exercises across the teaching sets. An alternative method would be to have one teacher marking across the whole year group. A clear indication of how marks have been awarded, preferably with a mark scheme, check list and appropriate comments (or ticks) on candidates' work, allows the Moderators to check that work has been marked consistently, and will lead to better differentiation of candidates.

Whilst the administration of Teacher Assessed Practical work is time consuming, the Moderators were concerned to find that, in some Centres, candidates appear to be entering their own marks on the Student Record Card. In at least one instance this caused an incorrect mark being used for the final total. It is vital that all marks are cross-checked before being transferred to the Centre Record Card. It is suggested that Centres using many experiments and having large numbers of candidates, fill in the basic details on the Student Record Card and then use a photocopier to produce enough copies. Final marks and candidate details can then be filled in at a later date. As previously suggested in the 1993 Report, it is very useful if the scores being carried forward from the Student Record Card are circled or highlighted. This not only makes it easier for the Moderators to carry out their cross-checking procedures, but also allows the Centre to ensure that the marks being submitted cover the sub-skills required. Centres must remember to complete the list of experimental details on the reverse side of the Centre Record Card. This list is also used for cross-checking by the Moderators. The checking process can be facilitated by briefly stating the skill being assessed, as well as the elements of the skill being covered e.g. graphs and tables or statistics, for each experiment. This could be written on either the Student Record Card **or** the Centre Record Card.

The Moderators were encouraged to find that most Centres had presented the practical work in a logical manner, with all work being easily accessible. There still remain a few Centres where the work is submitted in the form of practical books; these are extremely bulky and not easy to moderate due to the difficulty in accessing the work. In general, samples of work **packed by experiment**, rather than by candidate, are the most straightforward to moderate.

Skill A

It is again pleasing to report that the vast majority of Centres had clearly assessed safety in the laboratory, and not just assumed safe practices. The exercises used for Skill A were generally of A level standard, but care must be taken to ensure that any task has sufficiently complex instructions and requires a degree of manual dexterity that is appropriate for A level assessment.

Skill B

This remains the skill area which causes most adjustments to be made to Centres' marks. All too often, the two scores on the Centre Record Card were for practical exercises which did not cover the full skill descriptor. It also appeared from the Student Record Card, that, in some Centres, certain sub-skills had not been assessed at all during the A level course. Centres must ensure that the two pieces of work used to generate scores for this skill include practicals involving **microscopy**, **measuring**, **tabulation** and **graph work**.

In general, observation by drawing from the microscope tended to be generously assessed. Provision of clear marking/assessment points would help to prevent this. It is suggested that one practical could generate marks for measuring and microscope drawing, with a sensible allocation of marks. Too often Centres include marks for calculations of scale or size of object in the mark scheme. This is not strictly relevant to the skill assessment.

Centres are reminded that for the assessment of tabulation skills, the candidate is expected to produce their own table, without any prompting, in order to score high marks. The same is true for graph work. Some Centres used work sheets which told the candidates what to plot. This does not give the candidate access to high marks. A large number of Centres do not seem to be following the Institute of Biology recommended guidelines for tabulation and graph work. The most obvious faults are the use of units in tables; these should only occur in the column headings. In graph work, not always plotting the independent variable on the x axis is a common fault. A small number of Centres were awarding full marks to graphs which only had three points and tables of limited complexlty. The work produced by candidates must be sufficiently demanding for A level assessment.

Skill C

As previously mentioned in 1993, the Moderators were pleased to see most Centres assessing statistical analysis of results. However, such analysis must be used to produce conclusions as to significance. In a number of cases the work sheets used by Centres do not give sufficient opportunity for this to occur.

This year, very few Centres submitted lengthy pieces of ecological work for this skill, but of those that did, some included graph work as a Skill C assessment. The Centres are reminded that this assessment should be covered in Skill B and not credited for a Skill C assessment.

Paper 9260/0 Special Paper

General Comments

The quality of the scripts was very varied, with few outstanding candidates. There was a higher proportion of candidates who should not have been entered for the paper this year. Centres should bear in mind the aims of this paper, which is for the candidates to show a wider understanding of the standard A level material, and to be able to sustain a line of reasoning and argument.

Comments on Individual Questions

Q.1 Answers to this question were, on the whole, good and showed how much candidates enjoyed displaying their knowledge of biochemistry. Common errors included confining answers to only enzymes, or to only muscle proteins. However, most candidates gave a good balanced account of the relationship between structure and function in proteins. There were some good diagrams to illustrate arguments, and these should be encouraged when dealing with structure/function essays.

Q.2 This was the most poorly answered question on the paper, and illustrated the low level of experimental design skills that seems to underpin candidates' theoretical knowledge. Many candidates had not read the question and had their plants bubbling away in pond water, which did not attract credit. Some candidates thought this was their opportunity to write down everything they knew about photosynthesis, rather than pinpointing the precise nature of the experimental work that would test the limiting factors involved. Many candidates appreciated the difficulties of measurement in the field, though with new data logging equipment this should not be a problem. The majority of answers foundered on what they were going to measure as an indicator of photosynthetic rate. There were a couple of good essays which would have enabled the candidate to carry out the experiments, which after all is the test of a good experimental design essay.

Q.3 This was a popular question, with most candidates appreciating the biochemical and selection aspects of the topic. Candidates were stronger when dealing with the biochemical causes than in dealing with the selective pressures and the influence on gene frequencies. The term *heterozygous advantage* was rarely used, which was curious. A common fault was referring to *Plasmodium*

vivax as a virus.

Q.4 This was the least popular question on the paper and showed a wide range of responses with some candidates obviously being fascinated with entomology, and giving a wide variety of species examples as evidence for the arguments they were putting forward. There was the usual range of other Arthropods that strayed into the *Insecta*, and only a minority of candidates underlined Latin names. Candidates should be encouraged to appreciate organisms at all levels of complexity, including social organisation, as some answers gave interesting expositions on bees and ants, and discussing the adaptations these animals have for success in their particular environment.

Q.5 This question brought about some excellent answers which dealt with the Green Revolution in the areas of economics, genetic diversity, Third World population demands, and the Western market economy. There were some closely argued responses that showed a real understanding of the problems involved and what should be happening now. At the other end of the scale, some candidates misunderstood the question and wrote at length about the demise of the Green Party at the European elections, and any other environmental issue that they could think of.

Q.6 This proved a popular question, with good answers including many ongoing developing genetic practices in animal husbandry. Some detail about proposed genetic manipulation of 'milk' genes, and the implications of the release of these cows to the environment, was given by some candidates. Candidates should be encouraged to give indications of numbers of organisms involved in these processes as they talk about herds, or the ability of a bull to inseminate 'many' cows. Teachers are advised to give their candidates some consideration of the practicalities of some of the processes they describe in their teaching of this Option.

Q.7 This question allowed many candidates to display their intimate knowledge of basic plant developmental biology to the full, and elicited many good answers, dealing with all the events between fertilisation and germination. Less able candidates often missed out germination, or the process of fertilisation, or fruit formation, which lost them credit,. Many answers were well illustrated and showed careful diagram work, which should be encouraged.

BIOLOGY 9260

Component Threshold Marks

Component	Maximum Mark	A (1, 2)	B (3)	C (4)	D (5)	E (6)	N (7)	U (8)
1	40	32	29	25	21	18	15	00
2	70	42	36	32	28	25	22	00
3	100	60	54	48	42	36	30	00
4	30	21	18	16	14	12	10	00
5	60	44	38	34	30	27	24	00
9	60	53	50	46	42	37	33	00
84	30	21	18	16	14	12	10	00
85	60	34	27	24	22	20	18	00
89	60	53	50	46	42	37	33	00

Special Paper

1	46
2	40

Overall Threshold Marks

Component	Maximum Mark	A	B	C	D	E	N	U
1, 2, 3, 4 & 5	300	190	171	153	135	118	101	0
1, 2, 3, 4 & 9	300	204	183	164	146	128	110	0
1, 2, 3, 4 & 85	300	189	164	145	127	111	95	0
1, 2, 3, 4 & 89	300	204	183	164	146	128	110	0
1, 2, 3, 5 & 84	300	190	171	153	135	118	101	0
1, 2, 3, 9 & 84	300	204	183	164	146	128	110	0
1, 2, 3, 84 & 85	310	189	164	145	127	111	95	0
1, 2, 3, 84 & 89	310	204	183	164	146	128	110	0

The percentage of candidates awarded each grade was as follows:

GRADE	A	B	C	D	E	N	U
Cumulative %	16.5	34.1	52.7	70.0	84.6	94.0	100

The total candidature was 4190

These statistics are correct at the time of publication.