CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2003

BIOLOGY

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GENERAL COMMENTS

Candidate entry for Biology for the Caribbean Advanced Proficiency Examination, Unit 1, rose from 493 in 2002 to 588 in 2003 as a number of new centres participated. The number of Unit 2 candidates rose from its 2002 level of 140 to 352 in 2003. The total number of candidate entries for Biology in 2003 was 940, compared with 633 in 2002.

Examiners noted that candidates are still failing to use the rubrics, such as (a) (i) and (ii) to indicate the parts of the answers they are addressing. Examiners' guidelines require them to use discretion and insert rubrics on the candidate's paper where they should be. However, it is preferable for the candidates to clarify their own subsections, since marks are involved. It is also valuable self discipline in controlling and checking one's own answering technique. In Section A of both Units, when confronted with unfamiliar objects to be drawn, (e.g. mitosis, TS stem etc), some candidates revert to the memory of text book diagrams whose reality is far removed from the micrograph or photograph provided. When asked to provide procedures or predictions, candidates can recall book facts and sequences, but their capacity to suggest experimental steps or use knowledge to achieve a required outcome is weak.

Structure of the Papers

Paper 1 of Unit 1 and Unit 2

Paper 1 of both Units 1 and 2 were composed of nine compulsory structured questions each of which carried a maximum of 10 marks. The questions presented stimulus material such as graphs, photomicrographs and other data which challenged the candidates' skills of interpretation and analysis. The ability to follow instructions and to present material in a new format was also tested. Questions were designed to test both Knowledge and Comprehension (KC), and the Use of Knowledge (UK).

Paper 2 of Unit 1 and Unit 2

In Paper 2, Units 1 and 2, each paper was composed of nine questions, arranged into Section A and Section B.

Section A consisted of three structured questions, covering the three Modules and were based mainly, but not exclusively on the sections of the syllabus with a single underlining, testing experimental, drawing or interactive skills.

Section B comprised three pairs of balanced essays, providing a choice between the pair. Each pair was based on one Module of the syllabus and again tested the candidates on their ability to display their knowledge and comprehension as well as their use of knowledge skills.

COMMENTS ON THE PERFORMANCE

UNIT 1 PAPER 1

Module 1

The performance of candidates on Module 1 was satisfactory. The standard was marginally better in 2003 than in 2002. Candidates responded well to the memory questions, but were challenged by questions which tested their application and utilization of knowledge. This was particularly notable in Question 3.

Question 1

Performance on Part (a) was satisfactory, although answers for labels C and D were sometimes interchanged, and nucleus was given instead of nuclear membrane. For (b) (i) most candidates recognised mitochondria as the endosymbiont equivalents of aerobic bacteria, but less than half could name chloroplasts as the equivalent of unicellular green algae. Part (b) (ii) was a very simple recall question, but few students could name two structures.

Candidate had a general idea of the difference between tissue and organs, but their definitions were short, vague and not precise. In part (d), clues were given concerning the level used to classify first and second degree burns but the answers were still poor. Firstly the candidates generally failed to draw a complete horizontal line all the way across - they drew simple label lines instead. Secondly, many were drawn without regard to the level of the hair follicle cells.

Question 2

In Question 2 Part (a), candidates were asked to explain the meaning of the term "enzyme'. The majority of candidates gained the single mark by giving an acceptable definition, and about half were able to give three points to describe the effect of temperature on the rate of the enzyme-catalysed reaction. Those who did not score well failed to use any reference to the numerical values on the graph to support their point. A common misconception was that enzymes were denatured immediately after the peak of optimum reaction.

Performance on Part (c) (i) was unsatisfactory. Most candidates did not identify the process as end-product inhibition. In part (c) (ii) the majority of candidates scored one mark by stating that the level of C would be reduced, but few gained all three marks.

They should have added that enzyme X would act continuously on substrate A and that enzyme Y would have no substrate to act on. In Part (d), the two marks allotted showed that a substantial answer was needed. One word or a brief phrase that 'they would die' or 'reactions would be too slow' may have gained one mark. Enzymes work in pathways or cycles in sync with substrates and products, controlled by feedback systems. They are specific, fit the substrate exactly and produce particular end products. Their secretion can be controlled by hormonal action and they are linked to energy production (or utilization) at the exact capacity at which cell metabolism can operate.

Question 3

The structures in the drawing of the cell membrane in (a) (i) were generally correctly identified with the exception of two and four, which were often just called proteins: that was insufficient. No. 2 was an intrinsic, complete or transmembrane protein. No. 4 was an extrinsic, partial or inner protein. Any suitable descriptor was accepted. The hydrophilic head and the hydrophobic/fatty acid tails of the phospholipid needed proper labels. In Part (a) (ii), candidates who accurately labelled the glycoprotein and the channel protein were usually able to state their function.

Candidates performed poorly in Part (b). Although they knew the names of the molecules, they did not visualise that the fluidity of the membrane depends on the interaction of the molecules and their ability to re-assemble into a bilayer following a disturbance. In endocytosis the phospholipids around the rim of the cup-shaped depression unfold and re-arrange, creating a separate vacuole and re-sealing the membrane.

In Part (c), candidates showed a lack of understanding of how the cellulose cell wall is formed. It is formed outside the cell membrane, by secreting oligosaccharides through specific channel proteins which are then orientated and condensed into cellulose strands by enzymic extrinsic proteins on the external surface of the membrane. Up to two marks were allotted for this type of answer.

Module 2

Candidates' performance on Module 2 was on par with the performance in 2002, with virtually the same Module mean. Candidates responded well to questions related to Sociology and Reproduction, for example, Question 5 scored better than Questions 4 and 6.

Question 4

In Part (a) (i), about 70 per cent of the candidates identified the base-pairs correctly, but in (ii), less than half answered correctly. They selected the wrong strand, or failed to use uracil.

In Part (b) (i), candidates had already learned about sickle cells in their coursework, so should not have been entirely dependent on Fig 5.2 to understand the difference between the two types of blood cells. The cells were clearly distorted. Candidates were asked to give the conditions under which the distortion occurred. Many stated the reason for the change, but did not give the *conditions* under which it occurred. For Part (b) (ii), many candidates did not read the words 'inside the red blood cell', and mentioned excessive exercise and stress, without stating what happened to the haemoglobin itself, inside the erythrocyte.

Well over half the candidates named the enzymes correctly in Part (c). Part (d) is a common question and candidates should be taught and allowed to practice the calculation of the base composition of DNA, when given the quantity of percentage of ONE of the bases in the double helix. The mark scheme is normally designed to award marks for the stages in the calculations and candidates are therefore encouraged to show all stages of the computation to gain full credit.

Question 5

Question 5 was well done by most of the candidates, and several received full marks. There were good, relatively short answers with pertinent facts. This is what the examiners are looking for.

The main error in Part (a) was to identify K as meiosis I, and L as meiosis II. K was, in fact, mitosis, and L, simply meiosis, as both divisions were included in the brackets. Candidates writing excellent answers used the terms, diploid and haploid and referred to the quantity of DNA in units to support their decisions.

In Part (b), most candidates gave the correct answer: (i) gamete, and (ii) fertilization. In filling the table for Part (c), a brief statement was needed in each square to record the differences. One word answers or simplistic phrases failed to score. Candidates must help themselves by giving succinct, clear, indisputable answers. Part (d) (ii) scored better than Part (d) (i).

Question 6

Most candidates knew the labelled entities in Part (a) (i), Fig 7, but did not put them in the right order. Part (a) (ii), was very basic and as expected, was quite well answered.

Performance of candidates on Part (b) (i) was unsatisfactory. They were unable to work out that if 5-fluoro-uracil is similar to uracil, it would compete with uracil in complementary base-pairing during DNA to RNA transcription, especially if, (as the question states), the molecule is given in high doses, (which would increase its competitiveness). When 5 fluoro-uracil is incorporated into the mRNA, it does not allow correct codon formation and prevents amino acid assembly and polypeptide formation. The answer is virtually laid out in the question, and is related directly to the set of

drawings in Fig 7 on the previous page. Candidates should have been able to create three points for three marks.

In Part (b) (ii), candidates were challenged to absorb new information and compare it with Fig 7. Retention of and comparison of two or three concepts seemed to be difficult for at least half of the candidates. There were few good, well-reasoned answers. They should have commented on the possible effects of a different amino acid, (e.g.serine), being incorporated instead of the usual one (leucine) in the polypeptide.

Module 3

The standard of performance on Module 2 fell by about five marks this year when compared with 2002. Questions 9 was either unfamiliar, or showed time- related stress at the end of the exam, which could be circumvented by time proper management.

Question 7

In Part (a), most candidates were able to give correct definitions for recessive and dominant alleles. However, in about 50 per cent of cases, poor choice of words and expression reduced the clarity and quality of the answers.

In Part (b) (i), about half the candidates appeared to assume that brown must be dominant over yellow, probably by noting that all the sparrows in Box 1 were brown. They did not construct monohybrid crosses to deduce the answer from the 3:1 (61:23) yellow to brown F2 progeny, as shown in Box 2. Many of those who identified the alleles failed to express answers in the usual Punnet Square layout using genetic explanations to support them.

Only capable candidates did Part (c) (i) and (ii) correctly. Many were unable to complete the table or read off the critical values correctly. This style of question has been repeated often, and reduced to the most simple straightforward lay-out possible. Candidates have done better in the past and these questions will continue in the future, and should be practised.

In previous years, candidates have been asked to state ‘yes’ or ‘no’ as to whether they accepted or rejected the hypothesis that the features were being separated in a Mendelian fashion, (c) (ii). Candidates usually state ‘yes’ whether they have completed the table of not. This year they were asked to explain the ***reason,*** and few were able to find the words to indicate that they knew what they were doing or why they were doing it.

Question 8

In Part (a) (i) and (ii), candidates understood the terms ‘inversion’ and ‘duplication’, but were unable to construct diagrams of suitable standard, if at all, to show how these mutations occurred. Such diagrams are shown in texts, and candidates should be able to

replicate them, or create anew to demonstrate how these structural chromosomal changes occur.

In Part (b) (i) almost all candidates correctly identified a gene mutation as a change in the chromosomal structure, but a good, well-worded definition was rare. In Part (b) (ii), (a) and (b), the fact that chromosomes must be able to pair as homologous chromosomes, during synapsis in meiosis was not brought to mind in answering this question on sterility. Change in ploidy is in the syllabus, tetraploidy, and the creation of matched pairs of chromosomes allows compatible gametes to be produced, that is, fertility.

The question on the effects of colchicine Part (c) was satisfactorily answered, but Part (d) on auto- and allopolyploidy was not. However, for many candidates, this was the final question and they may have been under time stress.

Question 9

Most candidates performed well in Part (a), and approximately 50 per cent were able to create an acceptable set of dichotomous keys. Since this skill is tested regularly, teachers are requested to give the students plenty of practice.

In Part (b), many candidates did not know the names of the kingdoms. In this question, all the answers were provided in the introduction, to assist the candidates. They frequently referred to the genus as 'H', indicating lack of familiarity with the contraction of the term, Hibiscus. Candidates did not perform very well when asked to give just ***one*** distinguishing feature of ***three*** named kingdoms. Again, for most candidates, this was their last question, so time constraints may have been operative.

UNIT 1 PAPER 2

Section A

The performance of the candidates on Section A was unsatisfactory this year. This unsatisfactory performance was most evident in Question 2 where the mean score was less than two.

Question 1

Approximately 5 per cent of candidates scored full marks, but it was poorly done by the majority. Many candidates did not even attempt to fill in the table in Part (a), although food tests are in the syllabus (Unit 1, Module 1, Objective 1.10), and underlined as a practical skill. Page 39 of the syllabus states that Paper 2, Section 1 will consist of structured questions testing the application of practical skills. Clearly, those students who have the benefit of Laboratory sessions, and are required to write assessable reports on their Laboratory exercises should be able to answer this question from simple recall. In fact, it is a skill required in CSEC Biology, which is a pre-requisite for CAPE Biology.

It is a cause for concern that so few candidates felt they had the competence to respond. Apart from the few who scored well, most of the other attempts at this table failed to include the sequential steps and reasons. Teachers may wish to note this weak area and put more emphasis on helping students to overcome their lack of laboratory confidence.

In Part (b), most candidates managed to score at least three of the four marks awarded. The main error was the lack of the double bond in Part (b) (ii). Part (c) was fairly well done, and candidates knew at least one advantage of using fat as a storage material in preference to starch.

Question 2

Part (a) (i) was very challenging for the candidates. Drawings were rarely accurate or of the correct magnification, and few showed the thickness of the chromosomes, opting for 'stick figures' or textbook memories instead. Candidates were rarely able to identify both the type and stage of the division in Part (a) (ii). In the embryo sac, the haploid female nucleus divides three times by mitosis to produce 8 nuclei. This was metaphase, (early anaphase was accepted), of mitosis.

In Part (b), the testa was seldom identified as 'label L'. The word 'pericarp' and 'fruit' were used by some, which showed they were close.

For Part (c), candidates first had to draw the contents of the ovary, as is required on page 15, objective 3.3 in the syllabus. This should have been done in proportion to the outline. Few candidates were able to do this well. The integuments were drawn incorrectly, often floating in limbo in the locule, with no funicle.

The effort to import the rectangle, according to instructions and place it in the embryo sac did not meet much success. When imported it was not often drawn to match the scale, and to fit it into the drawing they had done. Surprisingly, there were several textbook drawings, complete with eight nuclei. It was rare, and in fact a joy to find an answer booklet in which this question was well done.

Performance on Part (d) was unsatisfactory. Figures 2 (a) and (b) showed nuclei, not cells. The nuclear membrane was labelled to draw this to the attention of the candidates, and it was stated under Fig 2 (a) and 2 (b) to try to prevent them from making an error. Two female nuclei each containing two nucleoli return to the centre of the embryo sac and fuse to give four nucleoli. Another two nucleoli are added from the male nucleus at fertilization, making six. The examiners are required to present questions such as this to the candidates to test their utilization and application of knowledge.

Question 3

Candidates performed well on Part (a) (i) and (ii) in completing Fig 3. They showed their ability to convert tabular information to a graph and histogram in a short space of time. Some did not know what 'best fit' meant, so teachers are asked to explain this. Some

used ink, and could not erase mistakes. Overall, everyone showed some degree of competence, and it was pleasing to mark.

For Part (b), many candidates gave only one or two deductions from the graphics they added to Fig 3.

They knew three marks were necessary, and should have searched the data for another point. Very few referred to the actual data in their answers. Examiners reported that some candidates did not know the meaning of the term 'percentage mortality', and frequently, babies of less than mean weight were called 'premature'.

Most answered Part (c) correctly by stating that babies of high or low birth weight were removed from the gene pool, and genes favouring mean birth weight were retained. Most candidates were able to remember the term 'stabilising selection'.

Section B

During the moderation exercise, Unit 1 Paper 2 was specifically adjusted to make it examinee-friendly; to decrease challenges in the layout and to simplify the application of the mark scheme. Despite this, the results were not on par with 2002. In 2002, the Paper 2 mean mark was 43.95, while in 2003, it was 38.73. This could be due to a larger number of candidates entering, whose essay skills need further improvement to meet the criteria.

Question 4

Although candidates were able to give the meaning of the terms of the four levels of protein structure, in Part (a), they did not have enough knowledge about collagen to exemplify them and gain all the marks. However, level 1 (the polypeptide chain), and level 2, (the alpha helix) were the same as for any protein so candidates could have put their minds to it to capture at least half of the available marks.

In part (b), about 60 per cent of the candidates were able to discuss some of the properties of collagen in relation to its distribution. Two marks were given for each property and its use in a function. Part (c) was a challenge to half the candidates. The cellular ribosomes are made by the nucleolus, and without nucleoli they cannot be made; messenger RNA cannot be translated; proteins cannot be made and the cells die gradually. Mitochondrial ribosomes are produced by mitochondrial DNA, so mitochondrial proteins can still be made from amino acids in the matrix. When the 'host cell dies, so will the mitochondria.

Question 5

Candidates performed well, describing glucose, starch and cellulose with freedom, but they had a tendency to write expansively, rather than concisely, and, from the lengths of their answers, it appears that many went well over the 15 minute time allotted. Time management in essays is an essential skill.

There was some confusion between alpha and beta glucose, and the bonds in amylose and amylopectin, but in all it was a good effort.

Part (b) tested the candidate's knowledge of the effect of properties of water on the maintenance of life. The points included the contribution of specific heat, hydrogen bonding properties, high heat of vaporisation and fusion and the density of ice.

In Part (c), some candidates did not grasp the question adequately. They tended to focus on the higher energy content in fats compared with carbohydrates, following on the introductory statement. The answer required was that more water is used for hydrolysis or condensation in carbohydrates than in lipids. Lipids have only three condensation bonds per triglyceride, whereas carbohydrates have one or more for every monomer, (two in branched polysaccharides). The fatty acid hydrocarbons of each triglyceride, when oxidised yield many molecules of water. Stored fat is a source of water as well as a source of energy.

Question 6

Candidates appeared to have little practical experience with real flowers, and with the methods which enhance cross pollination, (and prevent self pollination), as requested by the question. Few were able to name a plant, and then describe its floral parts and the structures which contributed to cross/non-self pollination, and explain how it was done. It appeared that candidates did not examine actual flowers, and rely on sketchily understood drawings and descriptions of mainly British flowers from the text. The syllabus, (Page 15, Objective 3.4 states 'non-synchronous maturation of stamens and carpels, separate sexes, insect pollination and self incompatibility'. The answers were rather poor for this level.

Answers to Part (b) were also very fair. Candidates who were stuck for an answer needed to systematically visualise the egg, its cytoplasm and inclusions, the nucleus with its haploid set of chromosomes, the membrane and the zona pellucida, which all have special functions. Four points were needed, but most candidates only gave two.

Part (c) was moderately well done, but candidates needed to analyse the question to ensure they covered all the points:

(i) amnion and development;
(ii) amnion and safety;
(iii) placenta and development;
(iv) placenta and safety.

Question 7

Candidates liked Part (a) and wrote out this 'recall' information in full. There were some excellent accounts. Answers to Part (b) were too simplistic, often answered in one sentence. Since there were four marks available, candidates should have provided four

well-explained points to earn these marks, Again the step-by-step strategy of setting out the facts in sequence and building up and answer can be used with benefit.

The performance in Part (c) was fairly good, with several candidates receiving four or five marks.

Question 8

There were many instances of candidates mis-interpreting the phrase 'biological-species concept', and this led to their writing desultory answers on species definitions, natural selection and related areas. While some candidates identified a species as a group of organisms that can reproduce to form fertile offspring, few went further to incorporate into their descriptions the concept that a species forms a reproductively isolated population of organisms.

Only the most capable were able to state some limitations of the concept. Concerning species formations, barriers between gene flow, such as reproductive isolation and subsequent diversity - even mutations were given. Allopatric and sympatric speciation and polyploidy were seldom introduced, (see syllabus Page 19 Objective 2.9)

For part (b), most texts explain the advantage of a heterozygous sickle cell genotype in relation to malaria. Normal haemoglobin genotype is of survival benefit, but so is a heterozygous sickle cell genotype.

For part (c), most candidates did well and were comfortable. It required a descriptive answer, based on relatively simple recall of information to which students are exposed at the CSEC level.

Question 9

In Part (a), candidates needed to explain five methods of species conservation. Each account received two marks. While candidates could name the methods, very little factual or practical detail was given. Temperatures for storage, water content, pre-treatments, harvesting methods, testing, economics, etc. associated with conservation were needed to show competence with the material.

Part (b) required candidates to have a firm grip on the basics of a dihybrid cross. Those who set out the cross procedure in a logical step-wise manner achieved some points. The better candidates knew that seeds needed to be germinated to reveal flower colour, and that records of crosses and offspring phenotypes should be kept, on which to base decisions. They were then able to suggest which crosses were needed to obtain the new genotypes. Part (b) tested familiarity and capacity to utilize and manipulate genetic crosses.

UNIT 2 PAPER 01

There was a definite improvement in performance in 2003 over 2002 in all three modules.

Module 1

Question 1

For Part (a) most candidates scored two of the three marks by identifying oxygen as the product of splitting water using light energy. The other products, electrons and protons were seldom mentioned nor shown in an equation, as part of the reasoning.

In Part (b) the candidates scored at least one mark for correctly identifying a sugar as the radioactive product. Additional marks were given for stating that carbon dioxide combines with ribulose diphosphate and enters the Calvin cycle. Few scored the last point by stating that the radioactive oxygen atoms are incorporated into glyceraldehyde-3-phosphate, which is used to generate sugars.

Candidates remarked on the first section of the graph, but did not discuss the levelling off phase. Very few used factual data from the Figure in their description, e.g. that the constant plateau of 11 units of ATP was reached at a light intensity of 80. Values must be given to substantiate deductions and earn marks.

Part (c) (i) seemed to present most candidates with difficulty, and full marks were rare. They did not focus on ATP production, but instead gave a vague answer such as 'light is no longer limiting, without realizing that ATP production occurs in the light-dependent stage and thus is unaffected by carbon dioxide concentration. The more able candidates recognised that enzymes may have been involved, but did not expand their answer to gain full marks. They did not refer to the fact that all the available ADP had been used, so that the hydrogen ion gradient is operating at its maximum capacity.

Question 2

Performance on Part (a) was satisfactory, as most candidates scored full marks for (i) and (ii). In Part (a) (iii), failure to give two products resulted in one mark only. In Part (b), over half of the candidates knew that lactic acid was oxidised to pyruvic acid, but few mentioned the regeneration of NADH2, thereby gaining only one mark.

Performance on Part (c) of this question was generally poor. No mention was made of the accumulation of alcohol, damaging the cell membranes. Candidates tended to re-state what was already known: that the cells died, rather than refer to the lowering of the pH by the build-up of carbon dioxide or accumulation of toxic products of metabolism, and decay, as reasons for the cells' dying.

Candidates rarely gave two advantages for Part (d). Most could name only one. The advantage most candidates cited was that the enzymes are more specific that catalysts. They could also have mentioned that enzymes can be left in the mixture, unlike inorganic catalysts, which have to be extracted; that enzymes do not yield unwanted byproducts, because their action is specific, and that enzymic reactions occur at living temperatures, whereas inorganic catalysts usually need high temperatures.

Question 3

In Part (a), about 80 per cent did not state that following a disturbance, a stable ecosystem gradually returns to the same stability. Candidates may not have interpreted the term 'disturbance' in the correct context. Only 2 per cent of candidates correctly answered Part (b) (i). Species D, (small fish) has three other food sources besides species A. There would be no net change nor effect on the ecosystem. No-one earned two marks. Candidates should have tried to present two clear and separate points.

Part (b) (ii) was received much better with 40 per cent gaining full marks. Candidates should have examined the feeding net more carefully, recognising that while species C would increase, predation by C would increase and members of the food chain below it would decrease.

Part (c) (i) saw only 10 per cent of the candidates being able to explain that nitrogen was made available via the presence of nitrogen-fixing bacteria or by nitrogen fixation due to lightning. Eighty percent of candidates achieved full marks in Part (c) (ii). Those who lost marks gave two instead of the three required answers. Part (c) (iii) was successfully completed by about 90 per cent of the candidates. The most common mistake was ending the graph line prematurely, that is, about 75 years instead of continuing it to 110 years, to be compatible with the original graph line.

Module 2

Question 4

In Part (a), 80 per cent of candidates correctly identified the capillary and gave an appropriate reason, but in Part (b), over half did not get the right answer, either because they did not know the diameter of a red cell; they did not measure the photograph, or know how to calculate magnification. **Each year, marks are lost by candidates due to inability to do simple magnification calculation, and teachers are asked to give this special attention**.

Most candidates gave the correct answer for Part (c) (i). In Part (c) (ii) structural differences and differences in speed and pulsation of flow were known and used by almost all of the candidates. They were challenged by Part (d) and all three marks were rarely achieved. Locating Part (c) (iii) (Purkyne tissue) was easier, for most than locating (i) and (ii).

In Part (e), candidates had difficulty providing two outcomes, and only 10 per cent scored both marks. In Part (f), candidates incorrectly stated that the narrowing of the blood vessel due to atherosclerosis would cause the blood pressure to decrease, rather than increase.

Question 5

This question was well done by most candidates. They knew the labels in Part (a) and about 60 per cent could recall the functions of calcium ions in Part (c) (i). Part (c) (ii) was not well done. Candidates were often imprecise, and few gained both marks on the role of the specific proteins in the post-synaptic membrane.

In Part (d), most candidates understood that the change from an electrical to a chemical/diffusion type of transmission provides more opportunities to influence the options at the synapse.

Question 6

In Part (a) candidates should have used the data, numbers and values to describe the volumes of gases, the length of time the volume was being produced and the effect of the increase of ethylene on the production of carbon dioxide. Three points were needed, with an explanation to earn the three marks.

In Part (a) (ii), it is respiration (energy production) which increases during days 9 and 10, and this powers the changes referred to in Part (a) (iii). These include the development of esters, flavours, aromas, production of pericarp pigments, the change from starch to sugar and the softening of the fruit tissue through the action of pectinase on the cell walls. Any one of these, expressed in a descriptive sentence (three lines were provided) would gain the mark, But answers were very varied and needed more substance.

Candidates answered Part (b) reasonably well, but did poorly on Part (c), the answer to which was anaerobic respiration or fermentation, (by bacteria or fungi on the fruit skins), which would spoil the fruit.

Module 3

Question 7

In Part (a), candidates correctly identified gene therapy. They should have added that the functional gene would allow the production of active adenine deaminase, and that the symptoms of the disease would not have been so severe. The methods of genetic screening requested in Part (b) was amniocentesis.

In Part (c), candidates were searching for a mother/baby method of gene introduction, based on the topic of the previous question, and some suggested genes in milk. Few cited encapsulated liposomes by inhalation for cystic fibrosis. For Part (d), most students

gained two points (which gave them three marks), but few were able to stretch their experience to find a third. These included collecting the kernels and testing for DNA complementary to that of the cauliflower mosaic virus; using recombinant DNA technology to compare the genotypes of the genetically modified with the indigenous maize; testing the herbicide resistance of suspected maize plants and comparing death rates of the plants.

Parts (d) (i) and (ii) each gained one mark. Answers could have included that the gene could have been incorporated directly into the genotype of the indigenous maize, or that the genes from the genetically modified maize could undergo recombination with the genes of the indigenous maize. For (d) (ii), the genes from the genetically modified maize could eventually be bred out if pure indigenous plants are used. However this is a theoretical answer, based on the fact that only one batch of maize is being investigated in the scenario set in the question.

Question 8

Many candidates identified the relevant points on the relationship between smoking and lung cancer in men in Part (a) (i). However, three observations were needed and should have been supported by the data. In Part (a) (ii), three differences between smoking trends in men and women included the fact that in women the increase in smoking occurs 30 years after the male pattern; it reaches 2700 cigarettes per person per year (maximum) as compared with 4400 in men; in women the deaths (mortality) peak 20 years after the peak in males; the male mortality is almost twice as high as in women, and in men there are signs of a decline in the death rate, while in women, the death rate is still climbing. Any of these points needed to be justified by use of pertinent data.

Part (b) was poorly answered. Most candidates gave nicotine as a carcinogen and few knew the names of carcinogens in the tar. In Part (c), most students could vaguely remember a little bit about dogs or mice, but were unable to describe an experimental method and to confirm the results.

Question 9

The answers in the chart in Part (a) showed that few candidates understood the effects of increasing amounts of alcohol on behaviour. The smallest amount given, 50 milligrams per $100cm^3$ is well within the legal limit and causes increased relaxation, reduction of inhibition, (friendliness), increased confidence and release from cares. Many candidates referred to hallucinations, unconsciousness and addiction at this level. Two well expressed effects on behaviour were required. Eighty $mg/100cm^3$ is the level at which driving is prohibited, and 80-$100mg/100cm^3$ shows impaired judgement and co-ordination, slowed reaction time, slurred speech and a staggering gait. Inability to see was not accepted. Again two good answers were expected for one mark each.

In Part (b), the advantage of a daily ration over a weekly allowance was understood, though here again, candidates failed to note the difference in degree of behaviour. These

one-glass-a-day drinkers were referred to as drunks, alcoholics and addicts. In Part (c) (i) many candidates realised that alcohol gets into the exhaled breath following absorption into the blood and diffusion into the alveoli. A surprising number said it was burped up, or that it stayed on the breath in the mouth as fumes or vapours.

Few candidates answered Part (c) (ii) correctly. The alcohol expired in the breath represents only a fraction of that in the blood, but it is in direct proportion, so that 35µg in the breath is indicative of 80 mg in the plasma. The breathalyzer is sensitive to this small concentration. For Part (d), blood and breath were not accepted. Urine, saliva and sweat were acceptable, while bile was not. Concerning physical and psychological drug dependence, candidates must learn this and accentuate the differences between them. There was too much overlap, leading to loss of marks.

UNIT 2 PAPER 2

Section A

There was moderate performance in this practical-based section, reflecting continued difficulty with drawing skills. This was particularly evident in Question 3.

Question 1

Most of the diagrams given in Part (a) were of very poor quality. The pencil-work, proportions of apparatus components and realism were very disappointing. As an aquatic system, the apparatus had to be leak-proof and air-proof. The plant needed to be included, drawn to look like pondweed, and placed so that oxygen could be measured an collected. It is apparent that few students are familiar with handling equipment in the laboratory and have almost no ability to draw conceptualized apparatus "from their minds". In short, their Lab experience appears to be below that expected and required for competence at the level of CAPE. The majority of candidates scored zero on an extremely simple CSEC-level piece of equipment.

In Part (b) candidates were able to transcribe the table correctly to graphical form, using the class intervals, the correctly identified axes and the values. Most obtained full marks.

In Part (c) (i), most candidates gained only one mark because they referred to the graph alone, and failed to correlate information from the graph and the histogram. Only the more able candidates recognised that the graph was the reciprocal of the histogram, and that where there is maximum absorbance, (red and blue on the graph), oxygen evolution (due to photosynthesis), is fastest - that is, the shortest time, as shown on the histogram, and vice versa.

Most candidates were able to supply one other limiting factor, (temperature, CO^2 levels). A few incorrectly gave water and oxygen.

Question 2

The majority of candidates followed instructions and copied the same size and shape to the space provided. Some failed to draw the inner surface of the leaf. A few drew textbook leaf shapes, without reference to the illustration provided. About 2 per cent drew the triangle and then squashed the outline of the leaf inside it. Many candidates drew actual cells, although they were instructed not to do so. The question tested the candidates' ability to follow instructions and draw to scale. Few candidates received four marks. Three or two marks were most frequent.

In Part (b) full marks were rare. Candidates confused the parenchyma, phloem and photosynthetic tissue. The latter should have been interpreted from the presence of chlorophyll. Hinge cells were seldom labelled, despite information being given on their location. This information was also intended to assist with the answer to Part (f), but was not often used.

Most of the answers to Part (c) were vague, mentioning sand and sea. The habitat description given at the start of the question should have helped to convey an environment with a salty, sandy soil, with a low water potential, which limited water uptake. Also high winds and full exposure to the sun would decrease the water potential of the air causing transpiration and water stress.

For Part (d), label H in the photo was 1 cm. At a magnification of 100, its actual length was 0.01cm (0.1mm). About half of the candidates scored the point.

For Part (e), most candidates mentioned the thick cuticle. Some failed to realize that the leaf had rolled inwards, exposing its lower surface to the environment and protecting its upper surface inside the roll. Some mentioned the hinge cells or the hairs, but both of these were on the upper surface.

In Part (f), about half the candidates suggested that the increase and decrease in size of the hinge cells, due to water content was responsible.

Question 3

Most candidates scored well in Part (a). In Part (b), fragment 1 was 8.5-9.5 Kilobases long, fragment 2 was 6.5-7.7, and fragment 3 was 5.1-6.3 Kilobases in length. Many candidates gave the correct lengths, but some reversed the order, in which case, credit could only be given for fragment 2.

Candidates were able to define 'gene therapy' adequately, though there was some confusion with genetic engineering and 'GM foods'. Half of the candidates gave an acceptable answer for Part (d). These included: a permanent solution; no further medication; lengthened life and ability; alleviation of symptoms etc. For candidates who stretched their imaginations, feasible answers were accepted.

Section B

Students performed fairly well in the knowledge and comprehension sections of the essay questions. They are still challenged by parts of the question dealing with the application and interpretation of information.

Question 4

In Part (a), most candidates had learned glycolysis and the Kreb's cycle by heart, and wrote them out very well, but full marks came from explaining how the pathways were linked. In Part (b), candidates needed to describe the sequence of steps involving membrane pumps, proton movement, electron cascades and ATP production, before explaining that cyanide prevents the re-union of 2H and 1/2 O^2 to form water. If this stage is blocked the electron transport chain is retarded then inhibited, and the ATP production ceases. Looking at the marks allotted, candidates should make sure that they have five clear recognizable steps or points for which 5 marks can be awarded. Most gained 3 or 4 points.

Part (c) was quite well done. Candidates understood that the 100 metre dash uses the ATP supplies and anaerobic respiration, which causes oxygen debt. 5000 metre runners pace themselves to use aerobic respiration, and avoid lactate accumulation. They did not explain adequately the metabolic reason for the post-race panting in one group and not the other.

Question 5

Candidates in Part (a) were required to give a specific example in each case, earning 3 points. Then for each, they needed to provide two or three descriptors to characterise, typify and distinguish between the terms. These statements should have been factual, and supply markable 'hit-the-nail-on-the-head' points which really score. In most cases definitions were partial. It seems that students have just not seen a niche or a habitat in actual life. They seem to be straining to recollect what is in the text, instead of remembering the clarity and fascination of a field trip.

Performance on Part (b) was much better, with candidates having a good pictorial grasp of the pyramids. They were asked to comment on 'shape' and 'accuracy'. The 'numbers' pyramid has relatively simple arguments on accuracy, and there were well recited. Biomass and energy have more complex concepts, involving dry mass, area/volume, standing crop, seasonal variation, life cycle and metabolic gains and losses. These were less well done, but overall, since this topic has been presented regularly in previous exam papers, the candidates' performance is improving.

Question 6

Part (a) allowed candidates to give a straightforward description of mass flow. They had to remember to relate this to the tomato plant. Many drew textbook diagrams of mass

flow and gave the textbook description, without reference to the tomato plant. Scoring was moderate.

Part (b) provided candidates with an opportunity to demonstrate competence in comparing methods by which substances are moved in the xylem and phloem, and distinguishing between the contents of the two types of transport tissue. Responses were fair. Answers were not sufficiently detailed, but the examiners required only 4 well explained points for the full 6 marks.

Candidates needed to recognise and analyse four questions in Part (c). They were:

(i) the effect of oxygen deprivation on water uptake;
(ii) the effect of oxygen deprivation on mineral salt uptake;
(iii) the effect of salinity on water uptake;
(iv) the effect of salinity on ion uptake.

These four answers, with full explanations would gain full marks. Candidates tended to bundle up the four issues, making extraction of the individual points difficult for the examiners. Most scored half marks.

Question 7

Candidates familiar with the syllabus requirements (Page 29, objectives 3.11 and 3.12), should know that haemoglobin can become 95 per cent saturated with oxygen at a partial pressure of only 10 Kp. The alveolar partial pressure of 13 Kp is in excess of that required for 95 per cent saturation. The haemoglobin loading system is adapted to accept oxygen under conditions at the respiratory surface and not of the atmosphere. Explanations were mixed, showing either competence or difficulty in manipulating the concepts and vocabulary. Some 'fumbled' while other omitted the section.

Part (c), required candidates to set out the concepts of homeostasis, and explain how they applied to metabolism. Set value, feedback mechanisms, maintenance of pH, water potential, temperature etc were all involved. Six homeostatic principles, well explained gave six marks. Most answers were satisfactory.

Question 8

Part (a) was well done. Most candidates wrote with gusto and accumulated at least 7 of the 10 points.

In Part (b), most candidates were able to correctly identify the categories of disease and give reasons for their answers. Most candidates gained 4 marks.

Candidates did moderately well in Part (c). They needed to refer to reverse transcriptase inhibiting drugs, and their effect in reducing DNA production from RNA. Protease inhibitors and cocktails of drugs need to be discussed, and the co-operation and discipline

which is necessary to follow the drug regime and to tolerate side effects as well as the enormous costs, distribution and politics involved. They did better describing the impairment of the immune system and the opportunistic infections which prevail. Candidates who read widely will bring these arguments to mind much more readily.

Question 9

As with Question 8, the freedom to express knowledge learned by straight recall enabled candidates to write extensively in Part (a), and several excellent accounts were given. Candidates need to monitor time spent, as equal time had to be reserved for the rest of the question.

For Parts (b) and (c), they need to rely on the step-by-step strategy of systematically creating markable points. They should state what they know about tumour cells - rapid growth and mitosis; susceptibility to radiation and anti-mitotics; spread through the blood and lymph; specific surface receptors, and then suggest the exploitation methods. Mutation of viruses is well known, and the need by the T and B lymphocytes to handle re-infection is also known. These challenging questions demand deeper application, and it is expected that better candidates will excel.

NOTE: Examiners noted that candidates are still failing to use the rubrics, such as Part (a) (i) and (ii) to indicate the parts of the answers they are addressing. Examiners guidelines require the examiners to use discretion and insert them on the candidate's paper where they should be. However, it is preferable for the candidates to clarify their own subsections, since marks are involved. It is also valuable self discipline in controlling and checking one's own answering technique. NOTE also, that while candidates can recall book facts, their capacity to cope with projected experimental facts is analytical situations is weak.

PAPER 3: School Based Assessment, Units 1 and 2

Over -view

Laboratory books were of a satisfactory standard and good attempts were made to cover the range of topics in the syllabus. The majority of the literature reviews presented attained only the minimum standard. The project reports were of a satisfactory standard and candidates demonstrated a creditable ability to collect original data, however, the analysis and interpretation of this data was non-existent or weak. The drawing skill of the majority of candidates was exceedingly poor.

Assessment of Skills

Each of the four Laboratory skills: Drawing (DR), Measurement and Manipulation (MM), Organization Recording Reporting and Presentation (ORRP), Analysis and Interpretation (AI) should be tested at least twice, using appropriately chosen experiments in the modules set out in the CAPE syllabus. This was not the case in many of the

laboratory books examined. In many instances, laboratory experiments from any module of the syllabus were used for the assessment any skill or of 1-3 skills simultaneously.

Drawing

The drawing skill demonstrated by many candidates was unsatisfactory. There was an inability to determine the level of detail required in a plan drawing versus a high power drawing and many of the magnifications noted were simply the power of the objective lens used to view the specimen and not a calculation of actual magnification. Clean, sharp, even lines; neatness; correct organization and orientation of cells was frequently absent. Thick, uneven lines, shading, smudges and ragged cell outlines characterized may of the drawings seen. Sufficient emphasis was not placed on the accurate representation of the specimens as seen in many "drawing mark schemes" submitted by teachers. It was also obvious that some drawings were copied from textbooks since structures such as spindle fibers and free ribosomes would not be visible under a light microscope.

Analysis and Interpretation

The AI skill of many candidates was weak and in some cased the laboratory experiments chosen to test these skill were unsuitable. The ability to analyze and interpret data and draw relevant conclusions is an indispensable skill in biology. The use of drawing to assess AI, where the student is given a known picture, electron micrograph or slide to draw does not allow for the genuine assessment of the skill. The use of food tests for AI, where well-known items such as milk, cheese and sugar are given as the test objects does not allow for the genuine assessment of AI. Unless unknown elements are introduced in an experiment where a student must apply theoretical knowledge to aid in understanding and analyzing the data, then analysis and interpretation cannot be deemed to have occurred.

Organizing Recording Reporting and Presentation

The ORRP skills of the candidates were of a satisfactory standard. The use of tables, diagrams, pie-charts, histograms, and graphs to clearly illustrate trends in data were used with some effectiveness by students. However, the determination of which method of presentation was the most appropriate/suitable for the type of data was not understood by some candidates.

Planning and Design

The planning and design skills were of a fair standard. The major weakness lay with the formulation of a succinct hypothesis with one variable which could be properly tested by a student with A'Level skills. In some cases, hypotheses were long and rambling and in others, several variables to be tested simultaneously were included. The design of an experiment to test their hypotheses presented some difficulty to students, where students were unable to distinguish between materials and apparatus,

neglected to include controls, and did not understand the limitations of the method chosen. A number of the experiment plans demonstrated a high level of complexity and sophistication such as to make one question the student input and/or origin of the experiment.

Projects and Literature Reviews

Literature Reviews (Unit 1)

Many of the literature reviews were of a minimal standard, where they were simple collections of paragraphs of information mostly from internet sources and books. Few attempts were made to link the information together in a logical sequence, to properly credit the authors of the information or to make a summary statement at the end drawing together the major points. Plagiarism was noted continually. Attempts were made by the Assistant Chief Examiner to locate some of the websites noted in the bibliographies and many of them had been moved or were no longer available. It is to be emphasized that several sources of information including books, journals and newspapers should be used in addition to reputable internet sources since one should be able to independently verify all information.

Project Reports (Unit 2)

Project reports were of a satisfactory standard. It was noted in some instances that Unit 1-type Literature Reviews were presented for Unit 2 Project Reports and these were accepted. Unit 2 Project Reports should be a demonstration of the student's ability to apply the scientific method to investigate some phenomena. The collection of data and analysis of the said data is the most important aspect of the project. The collection of data by use of a questionnaire was the method chosen by many students, however, the inclusion of the said questionnaire was neglected in some cases and conclusions were drawn without the data collected being clearly presented for scrutiny. The author of the questionnaire was often not clear.