CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2004

BIOLOGY

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GENERAL COMMENTS

There was an increase in the number of candidates writing the Caribbean Examinations Advanced Proficiency Exams in Biology in 2004. The number of candidates writing the examination rose from 891 in 2003 to 1416 in 2004. These comprised 410 Unit 2 candidates compared with 333 in 2003, and 1006 Unit 1 candidates, compared with 558 in 2003.

Teachers and candidates are reminded that there is reading time of 15 minutes in addition to the one and a half hour exam period in Paper 1 in both Units. Candidates need to make better use of this time, not just for gaining an extra 15 minutes writing time, but to peruse and assess the paper and decide which questions are preferred and the order in which to answer them. Candidates do not have to answer in the sequence 1 - 9. They can choose their best topics first.

Alternatively they may wish to flip through the paper tackling the KC (knowledge and comprehension) portions of each question first, and then return to the more challenging UK (use of knowledge) portions later, as time permits. At present in Paper 01, candidates spend too much time on Modules 1 and 2, and leave little time for Module 3. It would be valuable for them to spend even five minutes to evaluate the main topic of each question and plan an answering sequence that enables them to pick up easy marks.

Furthermore, candidates should note the value of each portion of a question. Marks are generally allotted on the basis of one mark for one good point with an explanation, expansion or statement to clarify it. If two marks are available, the mark scheme will obviously require two explanations, or perhaps four listed items. In CAPE examinations where, at present, no extra marks are gained by excellence in prose, candidates can do well by learning their facts in list/statement form, collecting rewards on a mark per point basis. For a

Paper 02, Section 2 Essay answer, a minimum of one factual, comprehensive sentence ***per point*** is to be aimed at. If a question carries 8 marks, then 8 - 12 to-the-point, progressive, sequential, descriptive statements should be adequate. Less than that, gains fewer marks.

DETAILED COMMENTS

UNIT 1 PAPER 01

Module 1

Question 1

This question tested the candidate's knowledge of the structure of the water molecule in relation to its biological roles. It also tested knowledge of the position and function of the cytoplasm/nuclear boundary.

In Part (a) (i), candidates clearly understood the concept of water molecules interacting with positively charged ions of the solute, but a common misconception was that hydrogen bonds were formed between water and the solutes. The fact that dispersion and interactions are enhanced was also given credit. In Part (a) (ii), the majority of candidates neglected to mention that as water cools its increases density (4 $^{\circ}$C), slows down kinetic movements and the molecules orientate themselves into 'crystals' or lattices. Although they mentioned that ice is less dense, and floats, they did not focus on the role of the molecular formation in reducing density, and strayed from the point of the question. In Part (a) (iii), most candidates failed to explain that heat energy is consumed in separating the previous adhesion or self-attraction between the water molecules. The term 'specific heat' was defined by several candidates but not taken further. The biological value obviously related to the general constancy of water temperature in the internal and external environment, despite fluctuations in environmental temperature.

Part (b) was quite well done, although some candidates failed to recognise that the electron micrograph only featured the nuclear area of the cell, and included other organelles in their labels.

In Part (c) (i), candidates who identified the nuclear pore correctly were also able to give its correct function, including the egress of long linear molecules. Some said it allowed 'things' to pass such as ions and gasses, but did not understand that the orientation of the polynucleotides at the portal was important. In Part (c) (ii), the nucleolus was identified accurately by about 50 per cent of the candidates, but many were not familiar with its function, stating that it was the site of DNA replication or that it controlled nuclear division. Production of ribosomal RNA was often omitted.

Question 2

Part (a) was fairly well done. Most candidates answered 1- ionic, 2 - hydrogen and 3 - sulphur bridges, but confused the rings in 4 with carbohydrates and used glycosidic bonding, instead of hydrophobic or Van de Vaals forces.

In Part (b), many candidates said the function of the prosthetic group was to combine with iron. Its function as an oxygen carrier should have been identified.

Part (c) was generally well done, but marks were lost due to imprecise answers, for example in B, the protein shape was an alpha helix, not just a helix, and in C, the protein structure was a beta pleated sheet, not just a pleated sheet. The abbreviation 1' and 2' for primary and secondary should be avoided.

In Part (d), though some answers were inexact, this question evoked a good response, citing hydrogen bonds or Van der Vaals forces.

In Part (e), for Test 1 butter, which is made from milk and milk proteins gives a positive purple test. Margarine, which is pure hydrogenated oil does not contain any protein, and so gives no purple result. Candidates seemed unfamiliar with the Biuret results.

Question 3

In Part (a), almost all the candidates were able to identify the molecule as glucose.

In Part (b) (i), mostly the alpha 1-4 linkage was correctly identified, but the 1-6 linkage was not.

Part (b) (ii) stressed that each building block is made of TWO units and that four blocks (of 2) were to be used in the diagram. This was to ensure an adequate number of bonds to reflect an intentional repetitive pattern in the bonding sequences when drawing starch (amylase) and cellulose. One of the four marks was reserved for compliance with this instruction.

In Part (c), enzymes in the human digestive tract could not digest cellulose to monomers such as glucose. Candidates failed to state that the lack of such absorbable monomers meant that no calories could be derived.

In Part (d), glycogen, a polymer of glucose, is traditionally referred to as 'animal starch' and produces a blue-black reaction with Iodine (in potassium iodide solution). A few candidates mentioned the reddish colour more typical of amylopectin.

Module 2

Question 4

In Part (a) (i), only a few candidates were able to demonstrate a knowledge of semi-conservative replication of DNA by actually drawing the appropriate DNA strands themselves. In Part (a) (ii), few could identify semi-conservative replication and the consequent labelling of the strands by radioactive thymine. Some candidates described meiosis, and the movements of chromatids.

Part (b) was well done, with many scoring full marks. Some candidates could not remember all the bases.

Very few candidates interpreted Part (c) correctly. Strain 1 was blocked at gene A, and strain 2 was blocked at gene B. However, even when the affected genes were identified, few candidates were able to explain their answers.

Question 5

In Part (a), candidates selected pro-, meta-, ana-, telo- and interphase, but some chose poor representative cells, rather than the clear and obvious ones.. They should have been sufficiently familiar with the material to have spotted five clear examples immediately.

Part (b) was a simple recall question which most candidates answered correctly.

In Part (c), mitosis preserves the genetic material of the cells, therefore cancer defects are passed on to the daughter cells. A common error was that the disease and not the genes were passed on during mitosis.

The correct answer in Part (d) (i) was 96 and Part (d) (ii) was 48. The most common error in Part (d) (ii) was 24.

In Part (e) (i), asexual reproduction was correctly answered by most candidates. In Part (e) (ii), since all the cells would posses the identical genome, they would be equally susceptible to the virus. The most common error was that the virus was passed on during mitosis and vegetative reproduction.

Question 6

Few candidates did Part (a) satisfactorily, and terms and descriptions were frequently mis-matched, for instance dioecious and monoecious. Protandry and protogyny were known, but correct outlines, as requested were confused and many obscure examples were put forward.

In Part (b), most candidates answered correctly that the pollen nucleus was haploid.

In Part (c), candidates reasoned well in Table 4, and most scored full marks.

In Part (d) (i), a plant with a rare allele will produce pollen (or stigma tissue) with the rare allele. Its rarity ensures that it is unlikely to

meet with another plant of the same genotype, and thus the pollen will germinate. Most candidates were able to reason this out.

In Part (d) (ii), similar alleles, for example, S1 in the pollen and S1 in the stigma, result in incompatibility. There is no fertilization and no zygote. Only dissimilar alleles are compatible and can form heterzygous embryos. Homozygous zygotes are not formed. This section was answered by about 30 per cent of the candidates.

Module 3

Question 7

In Part (a) (i) and (ii), two marks were available for each full definition. Brief or partial statements received one mark. Several candidates gave examples only. They needed to give a full, comprehensive definition of the terms.

In Part (b), the examiners expected the genotypes to be written: XGY, XgY or XGXG, XGXg However, many candidates wrote simply GG or Gg. This led to some confusion with the genotype for the males, where many candidates used two alleles instead of one. The majority of candidates gained at least half marks for this answer.

Question 8

In Part (a) (i), most candidates correctly identified the light moth as the one with the disadvantage. In Part (a) (ii), the camouflage factor in the environment had changed from light to dark bark., due to industrial pollution, leaving the light moth more exposed to predators than the dark moth. In Part (a) (iii), most candidates read off the correct figures, 125 light and 60 dark. In Part (a) (iv), the larger population of birds in the country would result in more of the 1000 released moths being eaten.

In Part (b), candidates tended to describe the method of natural selection, rather than to define it.

In Part (c), 'Directional Selection' should have been answered for (i), and stabilizing and disruptive selection for (ii).

Question 9

Candidates still find difficulty with creating dichotomous keys. The last three Chief Examiner's Reports have stressed that this challenge is included regularly. Despite this advice there has been little improvement in performance. Candidates are advised to study their texts in relation to this Topic and prepare themselves.

In Part (b), candidates were unsure of the differences between viruses and bacteria. Living verses nonliving, size, organelles and metabolism were the most common and acceptable answers.

In Part (c), the well-known statement, **K**ing **P**hillip **C**ried **O**h **F**or **G**oodness **S**ake stimulates memory of: **K**ingdom **P**hylum **C**lass **O**rder **F**amily **G**enus **S**pecies. (Use King **D**avid for **D**ivision in Plants). This should help candidates to distinguish between Family and Class, which only 50% could do. Answers for Gene and Allele, very basic information, were disappointing (see Syllabus, page 18 1.1). Few candidates were able to write one statement to distinguish between Allo- and Sympatric speciation.

UNIT 1 PAPER 02

Section A

Question 1

In Part (a), the majority of candidates were able to answer correctly. In the case of plant cells, determining the water potential of the bathing fluid posed greater difficulty. This suggests that the candidates had not actually viewed plant cells in osmotic experiments under the microscope. Many candidates failed to read that the question asked about the bathing solution, and not the state of the cells. Instead of writing iso-, hyper- or hypotonic they wrote 'turgid' or 'plasmolysed'.

In Part (b), the specific answer required related directly to the properties and components of animal cell membranes and plant cell walls. Most candidates cited the process of osmosis as the reason for the changes in cells sizes without reference to the red blood cell membrane properties and the cellulose walls. Definitions of the

terms iso-hyper- and hypotonic were also given as reasons for the change in sizes of the cells, although there were more references to the rigidity of the cell walls than the elasticity of the RBC membranes.

Part (c) was answered incorrectly by the majority of candidates. They were unfamiliar with calculations of magnification. This skill will be tested repeatedly, and needs to be prepared properly.

Parts (d) and (e) were answered fairly well.

Question 2

In Part (a), most candidates correctly identified A-E. For D, vascular bundle/tissue, phloem and xylem, were accepted. They had difficulty with F, the tapetum.

In Part (b), drawing skills were very fair. The compliance with a PLAN drawing was factored into the mark scheme. (compared with drawings of individuals cells). Realism, correct proportions, and an illustration of the positions and sizes of all the features labelled in (a) were required. Much more practice is needed in drawing skills, and a question such as this, which tests drawing ability will be given in Section A each year.

Part (c) used the formula: 'drawn size' divided by 'actual size' = magnification, (D/A=M), rearranged to give A=D/M, and that is 0.67mm, which candidates should recognise as being about right, since an anther is about a mm. Candidates often have so much difficulty with this very simple calculation that repeated classroom and lab practice is suggested.

Part (d) was quite well done.

Question 3

Part (a) was generally well done but a number of candidates had difficulty with dihybrid inheritance, and used a single pair of alleles, as in monohybrid inheritance. Others used different symbols for each of the 4 traits, rather than two pairs, which would have communicated the dominant and recessive alleles. Much practice is needed with selecting appropriate symbols, and diagramming the crosses accurately.

In Part (b) (i), candidates were required to write the observed numbers directly from the information provided, and then call upon their knowledge, the 9, 3, 3, 1 expected ratio. Nine quick calculations were required and marks were awarded for the correct answers at each stage. In Part (b) (ii) the sum was 0.36.

In Part (c), candidates appeared not to know what to do with their result: select 3 degrees of freedom, and choose the 5 per cent (0.05) probability column. These intersect at 7.82, which implies that the difference between the expected and observed results is insignificant. Some candidates chose 0.5 instead of 0.05, and quoted 2.37.

Section B

Question 4

In Part (a), candidates were asked for a precise description of the structures of the cell membrane. Instead of describing or annotating a drawing of the structures, many described their functions. Those who did focus correctly only gave fair descriptions - few gave any dimensions.

In Part (b), candidates misfocussed their answers. Instead of describing the membrane systems of the Golgi apparatus and the RER, they dealt mainly with function.

Chloroplasts and mitochondria were described, but the question asked candidates to compare the membrane systems of the two. For chloroplasts: the outer membrane, inner membranes (grana and thyllakoids, pigments, electron carriers). For mitochondria: outer membrane, cristae, stalked particles etc. were required. These two organelles are basically 'modified bacteria', and their value to the Eukaryotic cells is their membrane systems, and there are interesting differences between their arrangement.

Question 5

In Part (a), many candidates performed satisfactorily with good descriptions of the effects of the three conditions on enzymes and enzyme activity. Substrate concentration was the least well known and the most poorly explained.

In Part (b), many candidates rewrote parts of the question, and did not discuss the reasons for the substrate or bond specificity. Some candidates misunderstood and used trypsin to exemplify substrate specificity, and sucrase for bond specificity.

In Part (c), the basic answer expected was feedback inhibition, but candidates needed to identify at least 4 points from the illustrated sequence, and explain them well to gain 4 marks.

Mean score, 11.55. Range, 0 - 20. Chosen by 68 per cent.

Question 6

In Part (a), most candidates demonstrated a satisfactory knowledge of the male reproductive system. Drawings were fair. In most cases, it would have been more efficient to have annotated labels. Most candidates set out the drawing with the labels, and then wrote another page explaining the structure in words, and added facts about function. Many descriptions were wordy and confusing, and candidates wasted time, thereby compromising their scores in the last question. Candidates should understand that timing, and adherence to a time plan is an essential exam technique, especially for essays. Going over time on any question always penalizes another.

In Part (b), many candidates were not clear about the differences between the two types of pills. They produced good descriptions of the roles of oestrogen and progesterone in the normal cycle, but could not relate or apply the information to the question asked.

Part (c) was generally well done, with good diagrams, particularly of the sperm. Some candidates did not compare the sperm with the ovum. They were unsure about digestion, forgetting the function of the acrosome is to release these enzymes to digest away the materials surrounding the egg. They dwelt on the fact that the sperm must digest food for itself, and some even mentioned a mouth. The presence of mitichondria and the tail details were required for energy use and movement.

Question 7

In Part (a), many candidates used four diagrams to show mitosis, whereas five were presumed to be essential to show the details of

crossing over in meiosis prophase I. The question did not ask for cells exclusively, and cross over details could have been provided with chromosomes alone. They must choose from their range of knowledge what visuals are best included when trying to show this intricate series of events. Some candidates explained crossing over and rearrangement of exchanged parts, but annotated drawings ONLY were requested.

Part (b) was fairly well done, and many candidates gave three ways in which variation was possible, but did not elaborate on the points. They often presented the three points in one sentence. They were asked to describe these ways, and two marks were allotted for good descriptions of each.

In Part (c), candidates correctly identified mitosis, but did not think of this question in terms of the values (advantages) of mitosis as a process, and its disadvantages in self perpetuation when giving their answers. Some advantages are that mitosis can effect a rapid increase of cells; it ensures the same genotype as the parent; all cells are identical in genome; favourable mutations are perpetuated; only one somatic cell with the full gene complement is necessary. Disadvantages: mitosis does not provide for the introduction of a new haploid set of chromosomes; there is no exchange of genetic material; there are no mechanisms to correct the set and number of chromosomes following, for instance polyploidy or nondisjunction; disadvantageous genes or mutations are perpertuated.

Question 8

In Part (a), candidates could not clearly distinguish between the terms *insitu* and *exsitu* and did not separate the two properly in the answer. For instance, after defining the terms, candidates dealt with examples, but did not clarify which type they were referring to. Several included egg and sperm banks. It may assist candidates if they can learn lists of examples, to provide them with breadth for such answers, and then learn how to expand the lists with descriptions of each item.

In Part (b), there was some confusion in the responses given. Genetic engineering, gene libraries and DNA preservation concepts were involved in maintaining genetic diversity, but macro-level ecological defense systems world wide were seldom referred to. The value of

wild types: their resistance to pathogens; the susceptibility of highly selected genotypes to viruses; the maintenance of breeding units; the preservation of a rich gene pool; the preservation of un-researched animals and plants for future uses; medical and industrial uses; the preservation of a wide microorganism gene pool for food technology or biological controls and the adaptation and survival of kingdom populations of relation to micro and global environmental challenges. Five of these, or similar points, with a brief explanation for each would have scored full marks.

In Part (c), natural and traditional home areas should be preserved including any seasonal migrators. The area should be large enough to support a breeding population. All necessary species in the food chain, including aquatic members should be present. Predator-prey relationships should be in balance in the reserve. Evaluation mechanisms, even culling and research should be in place - plus financing. These are some of the components to work into the answer. Many students gave very brief lists, e.g. size, predators, food plants, etc, without expanding to secure their five marks.

Question 9

In Part (a), candidates were not adept at writing about failure of chromosomes to separate. Those who were, wrote about whole sets of chromosomes failing to separate, due to spindle non- formation, and how it would affect the genetic content of cells, but the terms non-disjunction and polyploidy were not always used to describe it. They could have also referred to Down's syndrome (trisomy 23), or the failure of sex chromosomes to separate, with the consequent irregularities, (XXX, XXY and XYY types) following fertilization.

Concerning changes in chromosomal structure, candidates had access to eight marks, and should have provided four well-described examples. Those who did gave very poor drawings, although, of course, line-drawings were accepted provided they were correct, and the results following addition, duplication, deletion, inversion or translocation were shown.

In Part (b), candidates were asked to discuss the principles on which the Five Kingdom classification is based. They are Prokaryotic/ Eukaryotic, unicellularity/multicellularity, autotrophs/heterotrophs, absorptive/ingestive feeding, degree of complexity, evolutionary

pathway. Once candidates knew some of these, they could express their view as to the applicability of these principles. The better candidates cited some of the principles, but many turned to the hierarchical divisions from Kingdom to species. They listed them and gave a brief description of each one. Scoring was low.

The Protoctista was not well known at all. Many candidates wrote about viruses and bacteria. They did not know examples of protists. They did not understand that protozoans such as amoeba and paramecium which are unicells using heterotrophic nutrition were in the group as well as algae, which are multicellular and autotrophc. There is a wide range of organisms with few features in common, and it is not a natural group. The majority of candidates obviously lacked experience with the concepts.

Candidates scored lower marked in Module 3 than in Module 2 and Module 1 because:

1. They had used up too much time on earlier questions, and did not have enough for these questions. Answers were sparse and hurried.

2. This Module is not well covered; perhaps inadequate time is allotted to teaching it and the difficult concepts it contains are not understood by the students.

UNIT 2 PAPER 01

Module 1

Question 1

In Parts (a) (i), (ii) and (iii), most candidates knew that carbon dioxide was fixed in stage 1 of the Calvin Cycle, but a common error was water. Most knew that water must be present for ribulose biphospate to complete the reaction, but a common error was minerals.

In Part (b), ATP was the energy source stated by most, but there were errors such as sunlight and ADP. Few candidates knew that reduced NADP was the electron donor referred to. Common errors were not using the phosphorylated form of NAD, or the reduced form of NADP.

In Part (c), two facts, the regeneration of RBP and the formation of carbohydrates were required for both marks. At least half stated both.

In Part (d) (i), granum was expected but thyllakoid was also accepted to compensate for any misunderstanding of the label. Common errors were lamella and chloroplast. In ii), few gained full marks for outlining thee processes in the chloroplast. Some confused it with respiration, and some could not distinguish between sites A and B, and therefore could not link the processes.

Question 2

Part (a) was quite well done, but a few candidates did not assign the 1st level of the pyramid to the producers in Part (i). In Part (ii), the answer needed to show an obvious reference to Figure 4, which did not identify the primary producers. So to say simply that "they feed on primary producers", without spatially identifying the producers is inadequate. Consumers always occupy the second trophic level and have the higher energy consumption.

In Part (b), several candidates failed to realize that the quantity of energy represented by level A, the producers, was the total quantity of energy entering the system, and then proceeded to total all the energy in the different levels to obtain a figure to calculate the amount of energy transferred from the producers. Furthermore, some candidates were unable to perform a simple percentage calculation. Most candidates recognized that heat is a major route for loss between tropic levels, but did not state that this loss was due to metabolic processes, such a respiration. Few mentioned loss from urine, faeces, the breath and sweat.

Part (d) was satisfactory.

In Part (e), marks were given for sequential stages of the calculation, and candidates were asked to show their working, so that the steps could be given credit.

In Part (f), most candidates failed to give the correct answer, that is, that the whales were tertiary consumers occupying the 4th trophic level.

Question 3

Although all candidates should have studied the electron transport chains which generate ATP, only the more capable candidates clearly understood the passing on of H+ along the chain and its ultimate combination with ½ O_2 to form water. They identified substance 10 as ATP in Part (i), but were unable to put arrow heads in the correct directions to match up with 11. In (iii), only a few of the candidates were able to identify which numbers (between 1 and 8) represented the reduced state of the carriers. The enzyme at 11 was often identified as cytochrome.

In Part (b), most candidates did not know that hydrogen was accepted from four of the reactions in the Krebs Cycle, though the syllabus states " outline the Krebs Cycle and explain its significance in ATP formation".

In Part (c), most were able to state that glycolysis is a source of hydrogen, but few were able to identify the pyruvate-acetyl co-A entry into the mitochondrion as being linked to hydrogen production. No one used the words 'oxidative decarboxylation', which enables students to link the fact that when CO2 is produced in these reactions, hydrogen is also released. In Part (ii), instead of saying how ATP was generated directly from a ground phosphorylation in glycolysis by incorporation of inorganic phosphate (this is such an important reaction in creating subsequent survivable energy from glycolysis that it should not be overlooked in teaching), they stated how many ATP's in general were formed.

In Part (d) (i), many of the candidates were able to say that when protons were moved into the inter-membrane space, the pH of this area decreased or became more acidic. In Part (ii), the correct response was that the protons diffused back to the matrix. Most candidates mentioned active transport, which would defeat the whole purpose of the energy -generating activity.

Module 2

Question 4

This was a question investigating how hormones and a neurotransmitter are admitted into cells through their membranes. There were two types of hormone: proteins and steroids.

Part (a), asked for one example of each type of hormone.

In Part (b), instead of realizing that hormones affect the nucleus, switching genes on or off, many candidates referred to mutations. Fewer than expected explained the nature of hormones in being effectors or repressors, and controlling protein production.

In Part (c), candidates should have been able to identify that the molecule which attaches to the receptor is acetyl choline, or they could have generalised with the word 'neurotransmitter substance'. In Part (ii), however, few understood that molecule B was a receptor for acetyl choline. This question tested application of knowledge of nerve cell membranes and neurotransmission at a synapse. In Part (iii), following stimulation of the membrane by attachment of acetyl choline, an action potential is initiated, and a depolarization of the membrane in which sodium ions move in and potassium ions move out.

In Part (d), cholinesterase is involved in breaking down the neurotransmitter (acetyl choline). Several candidates left this blank.

In Part (e), candidates were advised that Molecule A is a hormone. Hormonal action is controlled by feedback reactions. The inhibition of A by the product F is an example of negative feedback.

Question 5

In Part (a), the diagram of the artificial heart tested the candidate's understanding of its function as a fuel pump, with an intake and output flow. They were advised where blood entered and exited, both in the diagram and the text, and most were able to deduce the labels.

In Part (b), the majority of candidates correctly identified Z as the attachment for the pulmonary vein.

In Part (c), a large number of candidates disregarded the diagram, and explained how blood was circulated in the normal heart. They did not relate the artificial heart's pumping mechanism to the question asked, even though the question specifically referred to the artificial heart.

In Part (d), while the majority of the candidates were able to score one mark for the proximity of the lungs to the heart, many failed to cite the delicate nature of the lung tissue as a reason to require a lower blood pressure. The question asked why the right ventricle walls were thinner than the left. It did not ask why the left was thicker than the right, and many candidates dwelt on the need for thick muscle on the left. A number of misconceptions were identified, including different volumes of blood in the various chambers.

In Part (e), the majority of candidates were able to give suggestions on how to generate two different pressures. These were accepted if they were feasible - that is, if they took consideration of the fact that a person would have to LIVE with their modification, and that the heart had to be compact and portable. Addition of two extra pumps was therefore impractical, but varying the elasticity of the membrane was reasonable

Question 6

In Part (a), many candidates correctly choose sodium and protein respectively. A few confused the keys.

In Part (b), candidates did not perform well with the arithmetic required.

Some candidates confused ADH with ADP in Part (c). Others had misconceptions of ADH being released when urine is dilute or when blood pressure is high. The correct answer was that ADH is released when plasma osmolarity increases or when body dehydration occurs.

Most answers were satisfactory in Part (d) and involved dehydration and loss of solutes. Diabeties was cited correctly in Part (e).

Module 3

Question 7

In Part (a), about half of the candidates answered correctly in general, but few took any notice of Figure 10, and did not quantify their answers using the data from the chart. Answers were simplistic and

below the CAPE standard, and many candidates focused on the availability of medication and health care in developed countries, without understanding the significance of the word 'rising'.

In Part (b), half of the candidates could not distinguish between type I and type II, and could not describe type II. The syllabus defines "state" as to "provide factual information in concise terms, outlining explanations'. It describes "list" as to "itemize without detail". Those candidates who listed three points were not able to receive full marks. A "balanced" diet was mentioned, without reference to its constituents. Candidates suggested that no carbohydrates should be given to a diabetic. There were many such misconceptions.

In Part (d), less than 25 per cent knew why diabetics lose weight, eat more and produce more urine. They clearly did not understand the effect of insulin, or the fact that its lack results in reduced absorption of glucose into the body's cells, so that they need to metabolise fats and proteins to produce energy instead.

In Part (e), most candidates knew that glucagon was antagonistic to insulin, but few knew its action, merely saying that it increased blood sugar. A full two-line statement was expected, such as: "Glucagon, secreted when blood sugar is low, stimulates cells, particularly in the liver to covert glycogen to glucose to resupply the blood."

Question 8

In Part (a), for vaccination, candidates needed to say that the pathogen was inactive or attenuated, and that it is introduced purposefully to motivate the immune system. It is not correct to say that "a small amount of a pathogen is introduced". It must be treated to render it less dangerous. For Part (ii) the actual antibodies, made elsewhere in an organism, which can cope with the disease must be introduced, either artificially or from mother-to-baby.

In Part (b) (i), candidates should have been able to churn out the ready-learned sequence for the immune system response in a straight-forward manner. There was little challenge here. Those who knew their basic work could easily gain marks. Three well described points were needed. In (ii), the immune reaction is de-

creased as killer cells have invaded and reduced the pathogens, so that fewer antigens are being presented, and B cell stimulation is less. The Tc cells retard the number of B cells secreting antibodies. Some of this information should have been given.

In Part (b) (iii), the antigen has protein receptors which are already recognised. When the T helper cells present the protein pieces, memory cells are stimulated. Clonal expansion is very rapid as there is no requirement for clonal selection. B cells differentiate quickly into plasma cells, and antibody production occurs quickly. Those who knew their work did extremely well, but there were some spaces left by those who seem daunted by the immune system..

In Part (c), during phagocytosis antigens are engulfed, while Tc cells invade the organism, secrete perforins etc or destroy it internally by biochemical methods.

Question 9

In Part (a), this lovely question, presented at the end of the paper presented some difficulty to those who had not managed their time well. Most of them failed to use the tables properly, and did not use the information to support their points, so answers were generalised and unsubstantiated. One difference in age was needed, for example, that for protein, vitamin A or iron, or one difference for gender, for example, protein or iron - quoting the figures.

In Part (b), many candidates were able to accurately calculate the quantity to be 23.87g, but some did not spot the daily dosage at 350 g/day, and gave the amount per 100g. In (ii), since starving children have a lowered BMR, a sedentary habit, are dehydrated and have fewer enzymes etc, their nutritional requirements initially would be lower than normal, until a gradual re-adjustment was achieved.

In Part (c) (i), many candidates did this calculation well, but again did not allow for the dosage. On Part (ii), most candidates did very well.

In Part (d), candidates tended to use their limited general knowledge about milk instead of selecting precise information from the table to substantiate their points exactly.

Part (e) was very well done. Most scored full marks. Occasionally abdominal oedema was called an enlarged stomach. Biologists should be able to distinguish between stomach and abdomen.

UNIT 2 PAPER 2

Section A

Question 1

In Part (a), most candidates had the right idea, but many missed gaining two marks by giving shallow answers. The question asks about carbon gain. They needed to say that uniform light provides more light to the leaf surface than flecked light, and that light is essential for photosynthesis, which fixes carbon dioxide into carbon products.

In Part (b), the difference between carbon gain in Shorea grown in flecked and unflecked sunshine was:

(i) at 350 units CO2, 0.07, (range accepted, 0.06 - 0.08)
(ii) at 700 units CO2, 0.08, (range accepted, 0.07 - 0.09)

In Part (c), the average maximum photosynthetic rate of Shorea was:

(i) at elevated CO2 concentration (700 units), 53 - 57 units.
(ii) at ambient CO2 concentration 41 - 45 units.

In Part (d), the difference is 10 - 14 units.

In Part (e), candidates should know firstly that carbon dioxide is a limiting factor for photosynthesis, and that increasing the concentration increases the rate of the process. Secondly that CO2 is fixed into trioses which are converted into all carbohydrates, thereby increasing the carbon gain. This answer is not dissimilar to that in (a) above.

In Part (f), if all the enzyme sites are operating at maximum capacity, increasing the substrate concentration cannot increase fixation and carbon gain beyond the enzymic capacity. Most candidates got this point but comments including acidity or lack of oxygen were proffered.

Question 2

Parts (a), (b) and (c) were straightforward questions, and well done by most candidates with the possible exception of Part (c), on the calculation of the diameter of the pores. A generous range of size, from 0.45 to 1.25 micrometers was accepted.

In Part (d) (i), a fully compliant answer needed to include the following: "Water uptake increases from 5 grams at 11.00am to 28 grams at 6.00pm and then declines to 2 grams at midnight." This is not difficult to answer, but candidates gave brief, inexact answers. If there are 4 lines allotted , all four should be used, as the examiners have planned that this amount is required.

In Part (d) (ii), candidates were asked to comment on the transpiration rate. Their answers to Part (d) (i) & (ii) were meant to help them to focus on and formulate the answer to Part (d) (iii). In Part (d) (iii), answers deduced from either the ascending or descending graph line at 22 units of water uptake were accepted. In Part (d) (iv), excess water is used to maintain turgidity, for photosynthesis, enzymic reactions, cytoplasmic streaming, the prevention of desiccation or growth. Most candidates managed one of these.

Question 3

In Part (a) (i), candidates knew their facts, and answered quite well. Examination technique is important here. When two marks are awarded, at least two points are required, and they should fill the space provided. In Part (a) (ii), sexual transmission involving the exchange of viral-laden secretions, contaminated blood in transfusions or on needles used for intravenous injections. A one word answer was not enough. A clear explanatory statement was expected.

Part (b) (i) and (ii) were well done. Allowances were made for slight deviations in estimating the co-ordinates in (b) (ii).

In Part (c) (i), the two statements could have included the following: that AIDS cases are highest in the late 20's age group; failure to use condoms can result in AIDS or that low condom sales correlate with the highest AIDS incidence. In Part (c) (ii), candidates needed to identify the problem of varying class intervals used by the two data

centres, and to suggest that communication on the research activities or the methods of standardisation of the two Caribbean organisations is necessary to make the data useful to all other agencies.

Section B

Question 4

In Part (a), two clear points with a good explanation of each point were required to gain the two marks available. This pathway evolved in bacteria millions of years ago, and has become successful and almost universal because it is efficient and effective. But candidates have become so used to recanting the series of steps that they fail to investigate what the steps accomplish.

In Part (a) (i), answers were limited to "making glucose more reactive", and occasionally, "to make fructose diphosphate". The need to increase activation energy, the critical manipulations of the phosphate groups to increase reactivity and create the symmetry of the Fructose 1-6 diphosphate to open the ring and create two smaller, reactive trioses were overlooked. In Part (a) (ii), candidates confused ATP and ADP, since they knew the function of ATP, but obviously did not consider that ADP *had* a function or was in any way useful. Its role as an essential phosphate acceptor was not understood. In Part (a) (iii), the 'ground' phosphorylation is extremely important because it takes inorganic phosphate into the pathway, and is a prelude to the generation of the two profitable ATP molecules (out of the four produced) in glycolysis. Candidates had little idea about this step, but if it did not occur, there would be absolutely no gain from glycolysis. In Part (a) (iv), the nicotinamide acceptor accepts hydrogen and facilitates the progress of trioses towards pyruvic acid. Without this removal of hydrogen, pyruvate could not be formed and no energy could be derived, either from glycolysis or from the electron transport chains. In Part (a) (v), errors included: that the splitting of fructose into two trioses generates energy, or that since trioses were necessary, this had to be done. There was no mention of the 'opening' of the stable ring structure, the lower molecular weight, the availability of bonding groups or the fact that pyruvate, the end product of glycolysis is a triose.

In Part (b), aerobic respiration in animals was better known and explained than in plants. In animals, most candidates knew that pyruvate was turned to lactic acid, but many were unable to state how or why. They knew the reaction was reversible when oxygen was available, but again were not clear on how the hydrogen was removed to recreate the pyruvate. As to how the potential for energy conservation was thereby accomplished, they were not clear, occasionally referring to the energy which had already been expended (for the oxygen debt), rather than the opportunity provided for pyruvate to proceed to the Kreb's Cycle, where ATP could be reaped.

In plants, the conversion of pyruvate to ethanol, then acetaldehyde and carbon dioxide reduces the 3-C triose to a 2-C compound. This irreversible reaction loses the energy built in to the triose during photosynthesis. It is a loss of potential energy. In this question, candidates needed to look to the fate/function of pyruvate in the Krebs Cycle, and understand the significance of the loss of pyruvate. Again, it was necessary for them to understand the importance of the sequential steps in a biochemical pathway.

Part (c) was fairly well done, however, responses were generally limited to alcoholic beverages, mainly beer. Wines and spirits which are of economic importance to various countries were seldom mentioned. Only a few mentioned gasohol. A significant number discussed the social value of alcohol consumption. This fact, and the production of carbon dioxide in baking did not gain marks.

Question 5

In Part (a), the description of the carbon cycle, which candidates could do purely from recall, and which earned 50 per cent (10/20) of the total marks available was quite well done, but in an essay-type descriptive answer, they should remember that marks are given for well explained points. In this case they should have been in sequence. The examiners looked for points for which they could give credit and it was up to the candidate to make enough clear and solid points. Aquatic components of the carbon cycle and carboniferous deposits were almost always overlooked.

In Part (b), definitions between food webs and food chains were not clear and many discussions failed to distinguish adequately between them. The higher level discussions as to which one best represented greater accuracy in the feeding relationships of an ecosystem were very generalized and were seldom illustrated by specific references. Mostly there were generalisations of birds and insects and grass. There were very few candidates who seemed to show a knowledge or delight in the flora and fauna of any specific ecosystem, or display any personal biological zeal or understanding of ecology.

In Part (c), very few candidates connected the flow of nutrients within the ecosystem with the processes involved in nutrient cycling. There were four main areas of comparison between energy and nutrients:

1. The source - the sun for energy, reservoirs e.g. soil, for minerals.
2. Fixation and absorption processes: photosynthesis for energy and active transport etc for minerals.
3. Flow: one way for solar and cycling for minerals.
4. Loss from the system for both: energy (as heat) and minerals by oxidation, putrefaction, decomposition etc. Some of these concepts were a challenge to the candidates.

Question 6

In Part (a) (i), many candidates wrote more than was necessary. They should be guided by the marks allotted. Two marks. This indicates that two points well explained, or four points in statement format would be adequate. Two pages of writing represented bad judgement.

Part (a) (ii) was poorly done. Many candidates did not clarify ***how*** red cells not only carry oxygen, but carry ***large amounts*** of oxygen. Surface area, membrane permeability, 250 million molecules of haemoglobin per cell, the details of the high affinity and the facilitation of speedy on-loading by structural re-conformation of the haemoglobin, etc. were needed for eight marks. Candidates were awarded one mark for each well-described point.

In Part (a) (iii), selection by macrophages or Kuppfer cells in the liver, of damaged RBC's, lysis and recovery of components was required. Most knew what happened to the haemoglobin, but few

mentioned bile or the pool of amino acids resulting. Again, for two points, there should have been two well-explained points, or four pertinent statements.

In Part (a) (iv), several candidates wrote that haemoglobin was not filtered out because it was needed, showing not only a lack of comprehension of mass filtration and reabsorption, but a lack of understanding of the balancing forces of life. Some said that since the liver destroyed haemoglobin, there was no need to filter it out- oblivious of the time frame. Very few remembered that haemoglobin was ***inside*** the RBC and not free in the blood. Wherever it might be free, due to RBC damage, candidates should quote the molecular size. These questions, requiring precise answers, showed many flaws in the candidates' recalled knowledge.

In Part (b) (i), the candidates needed to utilize and apply their knowledge in this section, but many were unable to trace the higher levels of carbon dioxide from the air to the alveoli, blood and tissues. The effects of CO_2 on oxyhaemoglobin and on the pH of the blood was expected. In Part (b) (ii), candidates performed much better.

Question 7

In Part (a) (i), two marks were available for ***distinguishing*** between a motor and sensory neuron. Candidates tended to give a long description of each one separately and failed to identify their distinctions. In Part (a) (ii), candidates should have selected certain features and methodically described their structure and function, for example, cell body, myelin sheath, dendrons, dendrites, axons. Eight marks were available for straightforward recall answers giving eight clear, well presented answers.

Part (b), tested the application of the candidate's knowledge on synapse function. A diagram might have assisted candidates with reasoning out the answer.

In Part (c), candidates often forget that when they are taught about membrane transmission in neurons it pertains to unmyelinated neurons of annelids or molluscs. It should have been simple to describe, but few did it well. The information given on saltatory conduction in myelinated neurons with nodes was rather poor and brief. Four items of comparison were needed for the five marks.

Question 8

In Part (a) (i), candidates responded with long descriptions of pre-learned knowledge about the short and long term effects of alcohol on the brain, but they did not organise their information into the two categories of 'long term' and 'short term' effects. Many did not read 'on the brain', and wrote about the liver, social behaviour etc, thereby failing to conform to the mark scheme. In Part (a) (ii), two marks were available for this answer on tolerance, so two full points needed to be made. Those who wrote a page could not earn more than two marks, and should select material to match the reward available.

In Part (b), candidates needed to recognise the components of the question. They were: 1. the effects of cigarette smoking on the respiratory system, and 2. its effect on the cardiovascular system. The answers were recall-type: no reasoning nor deductions were required, just recitation of facts. Candidates should have been able to identify five ways in which cigarettes (nicotine, tars, carbon monoxide, toxins etc) affected the two systems. Few gave through answers tailored to the requirements of the question. Thoughts tumbled out with no management.

Question 9

In Part (a), transgenic organisms not only ***possess*** DNA/genes from another species incorporated into their genome, but they actually ***express*** the genes. That is why they were created - to produce the new phenotype. Few candidates understood this. In outlining the method by which these organisms could be produced, some candidates (as was expected), gave details on one method, while others gave an overview of several. Credit was given in both cases. Candidates were, however, expected to comply with one animal and one plant method, but many failed to describe both or generalised.

Part (b) was quite well done, but it was a complex question requiring two concepts, 1, environmental safety and 2, ethical implications, which then needed to be discussed in relation to genetically modified foods, **and**, human clones.

In Part (c), most candidates were able to define a 'restriction enzyme', but the majority were unable to describe the steps needed to remove a section of the genome. Candidates just need to learn this, step by step. A good definition, and three well described steps would gain the five marks.

PAPER 03: School Based Assessment, Units 1 and 2

Overview

The laboratory books were of a fair standard and the entire syllabus was covered in the majority of schools. A wide range of activities was used to reinforce the topics in the syllabus. The drawing skills of the majority of students were unacceptable. The ability of students to analyze and interpret data and to posit an explanation and draw a succinct conclusion was especially poor. The observation, recording and reporting was of a fair standard: A clear demonstration of an understanding of the appropriate use and effectiveness of different types of graphical representation was absent. In several instances it was not clear which practicals were used for the assessment of skills.

Mark Schemes

A high proportion of mark schemes submitted failed to place sufficient emphasis on the substantive elements of skills. In drawing, clarity and accuracy are the critical elements. Numerous mark schemes for drawing allotted 1/10 for titles, 4-5/10 for labels (labelling lines horizontal, lines not crossing, lines with no arrowheads, labels in script, labels correct, annotations), magnification 2/10 (calculation and/or stating), leaving a meager 3/10 for clarity and accuracy. For assessing drawing skills, 6-7 marks out of a total of ten should have been allotted to clarity and accuracy and three marks to labelling and magnification.

The Analysis and Interpretation (AI) mark schemes submitted showed deficiencies. In AI, the ability to relate the data collected to theory is critical, therefore, explanations and conclusions should have accounted for a minimum of 6 marks out of the total of 10. Four to Five marks for background information, which in a high proportion of cases was clearly taken directly from textbooks or given by the teacher, and a mere recording of results however presented.

The ORR mark schemes submitted were of a satisfactory standard and reflected the elements that were necessary for proper assessment of the skill.

It should be noted that all mark schemes, however configured, should be scaled to the appropriate mark and noted clearly in the laboratory books. For example mark totals out of 18 and 25 were received. In some cases the averages on the moderation sheets did not correspond to those noted in the lab books for the students. Some laboratory books were submitted without student names. In a few instances marks schemes were incomplete or not properly applied during assessment.

Drawing Skills

The drawing skills of many students were unacceptable. Poor drawings had thick, smudged, uneven lines; perfect circles and parallel lines created with a geometry aid; shading, cross hatching and stippling. In only a few cases, were the magnifications of specimen drawings calculated and inserted. Instead, students erroneously stated the power of the objective and eyepiece used to view the specimen.

Many, candidates were unable to determine the level of detail required in a plan drawing versus a high power drawing. Some drawings were copied from text books, showing free ribosomes, nuclear envelope, pores and plasmodesmata between plant cells which cannot be seen under a light microscope. In other cases, students in the same group had identical drawings. Good use was made of electronmicrographs to examine organelles and sub-cellular organization.

Analysis and Interpretation

The AI skills were weak. In a plethora of cases stimulus material, data, questions and methods from published literature or the internet was used in the development of laboratory practicals for AI and this information was not clearly presented in the students laboratorybooks or mark schemes to allow for a clear moderation of the exercise. Examples of these experiments included: the use of X-rays on mice, collecting the weights of babies, diagrams of apparatus with mercury in an open dish, human blood collection and examination. The

use of set questions to elicit explanations, discussions and conclusions by students is not acceptable. Students must apply theoretical knowledge to the analysis of results, discussing it concisely and formulating a conclusion.

Observation, Recording and Reporting

The ORR skills of students were of a satisfactory standard. Many books were well organized containing a Table of Contents, page numbers and appropriate titles for all the drawings, graphs and tables. The use of tables, graphs, pie-charts and histograms to illustrate trends in data was used effectively in number of cases and presentation was of a good standard.

Some of the methodologies presented for experiments contained insufficient detail. In a number of cases students neglected to give their tables, graphs and drawings (apparatus and specimen) appropriate titles. It should be noted that simple drawings do not lend themselves the proper assessment of ORR. Faulty grammar and spelling of biological terms were areas of concern.