CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

MAY/JUNE 2012

BIOLOGY

GENERAL COMMENTS

The CAPE Biology examination is based on three papers for each unit covered in the syllabus: Paper 01, a multiple-choice paper consisting of 45 compulsory items, 15 from each of the three modules; Paper 02 consisting of six compulsory questions, two from each of the three modules and Paper 032, an alternative practical paper for candidates who do not register for the School-Based Assessment. Paper 02 is divided into two sections: Section A with three structured questions, one from each module, and Section B with three essay questions, one from each module. Each question on Paper 02 is worth a total of 15 marks.

The modules in each unit are:

Unit 1

- Module 1 Cell and Molecular Biology
- Module 2 Genetics, Variation and Natural Selection
- Module 3 Reproductive Biology

Unit 2

- Module 1 Bioenergetics
- Module 2 Biosystems Maintenance
- Module 3 Applications of Biology

DETAILED COMMENTS

Paper 01 – Multiple Choice

The performance of candidates on Paper 01 improved significantly for both units. This was particularly striking for Unit 1 where the percentage of candidates in the Grade I category doubled (60 per cent) compared with 2011. Also for both units, the percentage of failures showed a marked decline to about 3 per cent. For both units, performance across the modules was consistent and no questions proved especially challenging for candidates.

UNIT 1

Paper 02 – Structured/Essay Questions

Section A – Structured Questions

Module 1

Question 1

Syllabus Objectives: 1.1, 1.5, 3.3
Highest Mark: 15 Mean Mark: 8.19 Lowest Mark: 0

Part (a) tested candidates' knowledge of the properties of water as well as an understanding of the importance of one of these properties to life. Part (b) was designed to evaluate the skill of plotting a line graph using water potential data, as well as the ability to describe and interpret the given data. Part (c) examined candidates' knowledge of the structure of a triglyceride.

Generally, the question was fairly well done with a small percentage of candidates attaining full marks. However, performance was found to be average for the majority of candidates; approximately 60 per cent of the responses were awarded scores ranging from six to ten marks.

In Part (a), some candidates were able to score all three marks by identifying the appropriate properties — *cohesion/adhesion and high specific heat capacity* — as well as correctly stating the importance of solubility to life. Most candidates scored only two marks because they were unable to state that water allows for solubility of compounds in order for these *to be transported or moved into and out of cells* or that *biochemical reactions occur in solution.* Teachers should ensure students understand fully the difference between how water acts as an excellent solvent of many substances and its importance to living organisms as a consequence of being a very effective solvent; the same approach should be applied for other properties of water. It should be noted that all substances have a specific heat capacity but water has a particularly ***high*** specific heat capacity and this contributes to its importance to life.

Overall, Part (b) (i) was reasonably well done with almost every candidate attempting to draw the graph. Most candidates scored at least two marks in this section with a number of candidates scoring full marks. Candidates were able to plot *at least six points accurately and produce a smooth curve.* However, marks were lost for *not stating the scale at the axis, not naming the x-axis or not including a title for the graph.* Many candidates who stated a correct scale for the graph failed to implement the scale at the x-axis. Instead, they plotted the values given for time of day equidistant along the x-axis and consequently the mark could not be awarded; some candidates did not know which was the x- or y-axis. Despite a noticeable improvement in the quality of graphs over the past few years, teachers should

continue to place emphasis on how various graphs are drawn in both practical and theoretical coverage of topics in the CAPE Biology syllabus.

Part (b) (ii) proved to be the most difficult section for candidates as the concept of water potential continues to be a challenge. In their description, candidates were expected to identify the three major changes in water potential in relation to time of day to gain a mark and then account for those changes in terms of *absence of sunlight, no water loss at night as stomata are closed or due to cooler temperatures at nights* and the *reverse during the day* to gain the remaining two marks. Candidates focused mainly on the description of the graph rather than accounting for its shape as required by the question. In their descriptions, candidates described the line as 'zig-zag', 'U' or 'W' shaped rather than describing the graph in relation to the values given in the x-axis and in the y-axis. Teachers should encourage students to highlight the critical features on the graph or table by using arrows or some other distinguishing label. This would help them to refer to these aspects of the data in their description. Teachers should also ensure that students fully understand the difference(s) between the terms *account* and *describe*. It should be noted that the general description of a graph and its interpretation are skills required for the analysis and interpretation activity in the School-Based Assessment component of the examination.

Part (c) (i), which was based on a diagram of a generalized triglyceride, was well done. Most candidates were able to identify *the glycerol and fatty acid chain/long hydrocarbon chain* parts of the structure. Also, Part (c) (ii) was well done with candidates clearly identifying the ester bond. However, some candidates in identifying the bond correctly included a label other than ester bond, for example, glycosidic bond. Part (c) (iii) proved problematic for some candidates. The question asked for a feature of the triglyceride which makes it a good energy molecule. Candidates were supposed to focus on the *higher proportion of hydrogen atom, long hydrocarbon chain, more C–H bonds or carbon atoms and much less oxygen compared to carbohydrates.* Instead, some candidates cited the insolubility of the molecule.

Generally, in answering a question, students should be encouraged to highlight a few key words in the stem, especially the command word so that the focus of the question is indicated. Also, they should know the differences between the command words. (This is given in the CAPE Biology syllabus.) This skill as well as others, for example, analysing data given in graphs and tables, can be practised in class and internal school examinations.

Module 2

Question 2

Syllabus Objectives: 1.2, 5.7
Highest Mark: 15 Mean Mark: 6.08 Lowest mark: 0

Part (a) focused on knowledge of some of the main steps in DNA replication and understanding of the significance of the term *semi-conservative*. Data on directional

selection was used for Part (b) to determine/test candidates' ability to interpret data on natural selection, presented graphically, and recognition of the type of selection.

Performance on this question was found to be satisfactory; Part (a) was widely known while Part (b) proved difficult for candidates. About 50 per cent of the responses attained scores of between six and ten marks while a small percentage of candidates were unable to gain any marks at all.

Overall, Part (a) (i) was well done. Candidates were required to give concise descriptions of the events, indicated at steps labelled 1, 2 and 3, of a DNA molecule during replication. Answers for Steps 1 (initiation) and 2 (elongation) were generally of a higher standard than those for Step 3 (termination). Some candidates could not be awarded the marks as their responses did not correctly match the highlighted steps even though the information given was accurate for DNA replication. Many candidates wrote about transcription and translation of protein synthesis instead of DNA replication. More than 50 per cent of the candidates scored at least two of the allotted six marks, with many scoring full marks. For Part (a) (ii), candidates were required to comment on the significance of the fact that DNA replication is semi-conservative. Many were able to score at least one of the two marks for stating either that *one half of the original strand is always saved* or that this *allows for exact copying of genetic material*.

Part (b) (i) explored candidates' ability to interpret data given in two graphs showing the effect of drought on a population of ground finches. Most candidates focused on the given information of population numbers and many did not refer to the frequency distribution. Many candidates scored one mark for stating that *the average beak depth increased after the drought* and then scored the second mark for quoting the *values (from 9.4 to 10.1 mm)* as instructed. Very few candidates stated that *drought favoured the survival of finches with the greater beak depths* or that *there was a decline of the number of finches with smaller beak depths (from 6 to 8 mm)*. Nonetheless, most candidates scored two of the allotted four marks.

In Part (b) (ii), candidates were required to use a simple diagram to illustrate *directional selection*, which was the type of selection illustrated by the data in Figure 3, for one mark and then make a comment for a further two marks. This section presented difficulty to candidates as few were able to draw a good diagram to illustrate directional selection. There were many 'sketchy' drawings of one curve that attempted to show directional selection and many interpreted the data graphs as showing stabilizing or even disruptive selection. Also, there were drawings of birds with increasing beak depths but with no descriptive annotations.

The comment for two marks required candidates to state '*directional selection'* and then to comment that *birds with short beak depth were selected against or died or, that birds with long beak depths were selected for or survived, and this caused a shift in the distribution to the right*. Many candidates described natural selection in general and not directional selection. However, some candidates were able to score the full three marks.

Module 3

Question 3

Syllabus Objectives: 2.2, 3.10
Highest Mark: 15 Mean Mark: 3.49 Lowest Mark: 0

For Part (a), candidates were provided with an incomplete diagram showing stages in the development of an embryo sac and were expected to complete the diagram for two missing stages. In addition, they were required to identify the point at which meiosis occurred and location of the female gamete. In Part (b), candidates were asked to identify five structures in a schematic diagram of the human placenta, and to comment on the function of one of the structures.

Generally, this question was not well done as only a small percentage of candidates were able to score more than 10 of the 15 allotted marks. Part (a) (i) proved to be quite challenging for some as in many of the responses diagrams were poorly done, incomplete or simply incorrect. Common errors included lack of correct orientation of the cells in the embryo sac for Stage A and, for Stage B, improper representation of the female gamete, antipodals and synergids as cells, and the polar nuclei as nuclear structures. While the majority was able to correctly indicate where meiosis occurs (C), not all were able to identify the female gamete (D). Too many candidates labelled the gamete based on recall of textbook material rather than in relation to the diagram drawn for Stage B. Part (a) (iv) was generally not well done as the majority of candidates were unable to score full marks. Some repeated information given in the stem while others gave incorrect or incomplete comparisons. Also, candidates seemed to be confused by the use of the term *angiosperm*.

In Part (b) (i), despite the use of a common textbook diagram of a section of the placenta of a mammal and inclusion of guiding labels, many candidates incorrectly identified the foetal artery and vein as being renal artery or pulmonary artery and vein. However, some responses correctly identified all the stipulated structures. Part (b) (ii) proved to be the most challenging section as in more than 70 per cent of the responses structure E, the *lacuna*, was identified as the amnion and as such the incorrect function was given, that is, shock absorption instead of *exchange of substances between mother and foetus or to prevent mixing of maternal and foetal blood.*

Section B – Essay Items

Module 1

Question 4

Syllabus Objectives: 2.2, 2.3, 2.7
Highest Mark: 15 Mean Mark: 5.08 Lowest Mark: 0

This question examined candidates' knowledge of the structure of two organelles, chloroplast and mitochondrion, and understanding of the difference in their main functions. Knowledge of the difference between a tissue and an organ was examined in Part (b).

This question was reasonably well done with about 20 per cent of the candidates gaining above average marks. In Part (a) (i), candidates were unable to gain full marks as clear descriptions of three structures were not given. Many mistakenly referred to both the mitochondria and the chloroplast as cells instead of *organelles*, or stated structures common to both without giving relevant details. For example, the majority of candidates simply identified *membranes* but failed to add *double,* or simply neglected to describe characteristics of the double membrane, that is, *outer layer is smooth while the inner is folded (branched).* Also, some correctly identified *ribosomes* as a structure common to both organelles without giving a description, for example, *70s* or *small* or *unbound.* Similarly, *DNA* was listed but no mention was made of the fact that it is *circular*. For Part (a) (ii), many candidates were unable to identify the main function of both organelles and instead gave details of photosynthesis and respiration. Others focused on a difference in structure rather than function.

In Part (b), a high percentage of candidates gave incomplete answers by simply stating that '*tissues are grouping of cells',* while '*organs are groupings of tissues'*, omitting to qualify the explanations by stating that a *tissue has a specific purpose* compared to an organ where *tissues work together for a common major role/purpose*. Many were able to give examples of both tissues and organs but were unable to use the dicotyledonous root to clearly illustrate the difference between the tissue and organ as specified in the question.

Module 2

Question 5

Syllabus Objectives: 4.2, 5.2, 5.3
Highest Mark: 15 Mean Mark: 4.39 Lowest Mark: 0

The ability to distinguish between gene mutation and chromosome mutation was examined in Part (a) (i). In Part (a) (ii), emphasis was placed on testing knowledge of sequence of changes leading to sickle-cell formation, while in Part (b), knowledge of gene therapy and understanding of application of gene therapy for cystic fibrosis was emphasized.

Overall performance for this question was average with only about 10 per cent of responses being awarded more than 10 of the 15 marks. In Part (a) (i), many candidates were able to correctly distinguish between gene mutation and chromosome mutation. Good responses stated that a gene mutation involved a *change in nucleotide sequence in a particular locus* and that this could *occur by substitution or deletion during DNA replication.* While many were able to describe chromosome mutation, not all made the link to the fact that *it is as a result of an error occurring during mitosis or meiosis*. Part (a) (ii) was generally not well done. Candidates were required to describe the sequence of changes triggered by gene mutation in sickle-cell anaemia. Few candidates scored full marks. While the majority stated that the *amino acid glutamine* (hydrophilic) *was replaced by valine* (hydrophobic), only a small percentage identified the *single-base change as being from CTC to CAC.* It was evident that many candidates did understand that the change in amino sequence resulted in a *change in the secondary, tertiary and quaternary structure* of the haemoglobin beta chain molecule but they neglected to mention that this lead to a *reduction in the solubility of the molecule which in turn caused polymerization of Hb S molecules into rigid fibres accounting for the 'sickling' of red blood cells.* Also, in order to gain full marks, the points had to be listed in correct sequence, as required by the question.

Part (b) (i) was fairly well done. Approximately 40 per cent of the responses gained full marks for outlining four key steps as follows: *a copy of the normal gene must be isolated, inserted into a vector, then introduced into the transgenic virus/bacterium, cloned and re-introduced into a patient.* A common misconception was 'cutting out the defective gene and replacing it with a healthy one'. Very few candidates were awarded the full two marks for Part (b) (ii), as many were unable to accurately comment on one difficulty in using gene therapy to treat cystic fibrosis, for example, *problems in method of delivery, treatment being temporary, possibility of patients eliciting an immune response to the viral vector or need for the therapy to target specific cells.* Several candidates mistakenly dealt with the disease and not the gene therapy.

Module 3

Question 6

Syllabus Objectives: 1.1, 1.2, 2.6, 2.7
Highest Mark: 15 Mean Mark: 6.87 Lowest Mark: 0

In Part (a), the aim was to examine candidates' ability to distinguish between binary fission and budding, as methods of asexual reproduction. Part (b) tested candidates' knowledge of stages leading to fertilization after germination, and understanding of the significance of double fertilization.

Overall, the question was generally well done, even though only a small percentage of candidates gained full marks. However, despite the simplicity of the question, some parts posed difficulties for candidates. For example, Part (a) (i) proved to be challenging for a large number of candidates. While the majority of candidates correctly identified binary fission as a *process by which the original organism divides by mitosis to produce two identical cells*, there were many misconceptions surrounding budding. Many candidates did not deal with budding as a form of asexual reproduction and incorrectly referred to budding as the process by which a bud fell off a plant and gave rise to a new plant. However, a few candidates correctly described budding as a *process, not involving mitosis, by which a small part of the parent is pushed out from the parent, becomes detached and then exists either separately or in a colony.*

Part (a) (ii) was fairly well done, with at least 80 per cent of the candidates demonstrating a sound knowledge of the advantages and disadvantages of asexual reproduction. Though many candidates were able to correctly state an advantage and/or a disadvantage, many did not fully discuss these points as expected, for example, *easier as only one parent needed or the fact that lack of genetic variation could be detrimental.* Nonetheless, several candidates gained at least three of the four allotted marks.

Part (b) (i) yielded a range of scores based on the given number of sequential steps leading from germination to fertilization; in some cases responses were below the expected standard. Although fairly well done, there were many candidates who appeared to have misread the question and dealt with pollination rather than germination or who incorrectly focused on pollen grain formation. Good responses gave a clear description of the sequence of events starting with the *formation of the pollen tube, its subsequent growth down the style to the ovary and entry into the embryo sac to end with fertilization.* Included in these responses was the *splitting of the generative nucleus to form two male nuclei which were discharged into the embryo sac via the micropyle upon degeneration of the tube nucleus/bursting of the pollen tube*. Excellent responses mentioned that *both male nuclei were fused with nuclei from the embryo sac or more specifically, with the ovum and polar nuclei respectively* and hence were able to gain full scores.

In Part (b) (ii), the majority of candidates seemed to recognize that double fertilization led to the formation of the embryo and the triploid endosperm. However, many candidates failed to comment on the significance of the event, that is, the *role of the endosperm in providing nourishment for the developing embryo.* This failing contributed to a lower standard of performance. Based on the responses given, it is clear that candidates did not understand what was meant by *significance* and focused more on giving a description.

Paper 032 – Alternative to School-Based Assessment (SBA)

Module 1

Syllabus Objectives: 4.5
Highest Mark: 16 Mean Mark: 13.71 Lowest Mark: 8

Question 1

This question was very well done. Most candidates gained at least 13 of the allotted 16 marks. Candidates were given a list of apparatus and material to investigate the effect of substrate concentration on the rate of reaction of catalase.

Part (a) was successfully done as most candidates recorded the height of bubbles formed; a few candidates gave unrealistic values. For Part (b), most candidates wrote an appropriate title for the table, for example, *Effect of substrate concentration on the activity of the enzyme catalase.* Part (c) was accurately calculated using results obtained. For Part (d), the relationship between substrate concentration and enzyme activity was accurately stated by most candidates. They were able to clearly identify the purpose of distilled water in tubes D and D1 as being the *controls for the experiment* (Part (e)). Part (f) proved to be the most difficult section for candidates. Few were able to include a design which gave the hydrogen peroxide concentration as the controlled variable and the temperature as the manipulated variable in the procedure.

Module 2

Syllabus Objectives: 2.6, 2.7, 3.2
Highest Mark: 16 Mean Mark: 6.84 Lowest mark: 0

Question 2

This question was difficult for most candidates as approximately 50 per cent scored between zero and six marks. In Part (a) (i), candidates were given plastic ties of three different colours and three different lengths. They were required to use this material to construct a model of the structure of a bivalent for two chromosomes at the end of prophase I. In constructing the

model, *bivalents, for any one chromosome, should all be the same length, comprising of two pairs of ties with each pair consisting of a different colour and with centromeres correctly positioned*. Most candidates failed to construct acceptable models. Areas of weakness included omission of a chiasma in the model, not correctly arranging the bivalents as they appear at the end of prophase of meiosis I, and neglecting to show the cylindrical shape of the centrioles and the radiating spindle fibres or representing them incorrectly.

Part (b) was generally well done with most candidates gaining full marks. Candidates correctly identified the parental genotype for colour blindness as *Male:* X^aY *and Female:* X^AX^a *or*X^aX and used the Punnett square to accurately demonstrate the cross. However, some failed to correctly represent the gametes even when they gained full marks for Part (b) (i). For Part (b) (iii), many candidates failed to identify the heterozygote as a carrier female; many stated *not colour blind*. A few candidates referred to the colour-blind male as a carrier.

Module 3

Question 3

Syllabus Objectives: 3.1, 3.2
Highest Mark: 14 Mean Mark: 9.44 Lowest Mark: 4

This question evaluated candidates' knowledge of reproductive structures and their functions. Most candidates gained 50 per cent or more of the available marks. Part (a) (i) required candidates to make a labelled plan drawing to show the distribution of tissues in the testis. Many candidates produced high power drawings instead of plan drawings. Of the few who produced plan drawings, some included cells and failed to represent the tissues in correct proportions. Many omitted magnifications and a title. However, most were able to accurately label the drawings.

In Part (a) (ii), most candidates were able to annotate the labels indicating where sperm and testosterone are produced. Few of them identified the role of the tunica albuginea in maintaining the integrity of the testis.

Candidates had their best score for Part (b). Almost all candidates correctly identified labels A to E as the *fallopian tube, ovary, uterus, cervix and vagina* respectively. Most gave correct annotations to indicate fertilization of the ovum occurring in the *fallopian tube* and implantation of the zygote occurring in the *uterus.*

UNIT 2

Paper 02 – Structured/Essay Items

Section A – Structured Items

Module 1

Question 1

Syllabus Objectives: 1.4, 2.5, 2.9
Highest Mark: 15 Mean Mark: 6.2 Lowest Mark: 0

The first part of this question tested candidates' knowledge of the Calvin cycle, understanding of the purpose of the main phases and the difference between this cycle and the Krebs cycle. The second part of the question focused on aerobic/anaerobic respiration and in particular the relationship between oxygen debt and build-up of lactic acid.

Overall, the question was fairly well done with about 15 per cent of the responses being awarded more than ten marks. Part (a) (i) was not well done as many candidates were unable to correctly indicate the stages at which ATP or NADPH is used and, for those who did, several neglected to include the number of molecules. Fairly good responses were given for Part (a) (ii) with at least 70 per cent of the candidates being able to correctly outline the main purpose of the stages, that is, *carbon fixation*, *reduction* and *regeneration*, highlighted in the figure. Some misconceptions included suggesting phosphorylation or focusing on RuBP. Part (a) (iii) seemed to have presented little difficulty as at least 85 per cent of the responses stated a correct difference between the Calvin cycle and Krebs cycle. Some candidates were unable to give a comparative difference, thus suggesting that an understanding of what is required continues to pose problems for candidates. Answers to Part (b) (i) were of a higher standard, with candidates being able to adequately describe changes in blood lactate and glucose levels to gain at least three or even full marks. Poor performance was due to either incorrect comparisons or inaccurate interpretations of the graphs. Part (b) (ii) was fairly well done with some candidates giving excellent responses stating that *blood lactate levels increase because of an accumulation of lactic in the muscles creating an oxygen debt.* A common error was failure to link lactate with the demand for oxygen. Part (b) (iii) was poorly done. Many candidates described the outcome, that is, an increase in the cyclists' performance but did not comment on the significance of this with respect to aerobic performance.

Module 2

Question 2

Syllabus Objectives: 1.1, 1.5, 3.4
Highest Mark: 15 Mean Mark: 4.71 Lowest mark: 0

This question tested candidates' knowledge of certain structures of the mammalian heart and their respective functions. Transport of water and ions in root cells was the main topic being tested in the second part of the question.

Overall performance for this question was below average with about 70 per cent of the candidates scoring less than eight marks. For Part (a) (i), many candidates did not give annotations describing the structures highlighted in the diagram but instead focused on functions; less than 50 per cent of the responses gained full marks. Expected answers included *node (small or compact area) of specialized muscle (myogenic)/nerve cells* for A and C, *thin-walled chamber for B, modified cardiac fibres (Purkyne) for D and thick-walled chamber* for E. Part (a) (ii) was also not well done as many candidates failed to clearly state the roles for structures A, C and D as being *pacemaker* for A, *delaying or slowing of electrical signal passing down to ventricle* for C and *conducting electrical signal to ventricle* for D. Part (b) proved to be challenging, as either incorrect locations were indicated or arrows were not used, and poor or inaccurate outlines were given for the movement of ions at the locations. Weak or incomplete explanations of the relationship between the movement of ions and water were given for Part (b) (iii) that is, *a high concentration of ions created a more negative water potential causing water to move in the root cells by osmosis.*

Module 3

Question 3

Syllabus Objectives: 1.4, 3.1, 3.3
Highest Mark: 15 Mean Mark: 10.8 Lowest Mark: 1

This question was designed to test candidates' understanding of mortality rate and their ability to plot and analyse data on mortality rates in the form of a bar chart. The second part of the question focused on a balanced diet and analysis of information presented in the form of a pie chart.

Overall, this question was quite well done with approximately 70 per cent of the candidates gaining ten or more marks; full scores were attained by more than one per cent of the candidates. It is clear that candidates have mastered the skill of plotting a bar graph and had a good understanding of the relevant topics. For Part (a) (i), a few candidates mistakenly drew a line graph or a histogram instead of a bar graph as expected. Failure to include a key, to use distinct bars and errors in plotting values accounted for loss of marks. Part (a) (ii) was well

done with the majority of candidates being able to accurately comment on the trends shown for cancer and diabetes. Almost all of the responses correctly identified *heart disease* as the leading cause of death. Part (b) was not as well done. This was in part due to the fact that many candidates were unable to give a complete explanation of the term *balanced diet*, which is the *right types of foods, in correct proportions to supply adequate nutrients or maintain health.* For Part (b) (ii), many candidates did not make reference to information given in the pie chart but instead used their general knowledge of the topic to answer the question. Part (b) (iii) was quite well done as most candidates were able to comment on one health consequence of consuming fats in excess — *obesity, diabetes and heart disease* were popular answers.

Section B – Essay Items

Module 1

Question 4

Syllabus Objectives: 3.2, 4.4
Highest Mark: 15 Mean Mark: 5.82 Lowest Mark: 0

This question tested candidates' ability to explain the terms *species diversity* and *stability* of a community. Additionally, an understanding of why there may be a positive correlation between species diversity and ecosystem stability was examined. The second part of the question focused on candidates' ability to define the term *food chain* in terms of energy flow and to evaluate whether there is an understanding of why a food web better describes energy flow in an ecosystem than does a food chain.

Performance on this question was slightly above average with only about ten per cent of the candidates being awarded ten or more marks. Part (a) (i) was generally lowscoring. Very few candidates were able to fully explain species diversity to incorporate both the *variety of species* present in a community and *their relative abundance*. In teaching the concept of species diversity, it is recommended that teachers distinguish between species diversity and the variation that exists between organisms of the same species, as this was an area in which there were misconceptions. Even fewer candidates were able to give a comprehensive explanation of the *stability* of a community. Many candidates incorrectly referred to stability simply as a *well-balanced ecosystem*. However, the more capable candidates were able to gain full credit by stating that stability was a *measure of the community's ability to withstand change and to recover from change to former levels of species richness after a disturbance.* Part (a) (ii) was fairly well done. Even though most candidates recognized that communities with high species diversity were more resilient and resistant and thus more stable, the responses revealed that the concepts of resilience and resistance were not well understood.

Part (b) (i) was also generally well done. The majority of candidates were able to define a food chain *as the sequence of steps through which the energy stored in autotrophs (primary producers/plants/other photosynthetic organisms) passes to higher trophic levels.* In Part (b) (ii), the majority of candidates explained several ways in which the food web was better at describing energy flow in an ecosystem than the food chain. Candidates typically made reference to the fact that the *food web was more complex than the food chain* as it included a larger variety of organisms. Another common correct response was that the *food web was better able to show the relationships between organisms, as it was a network of interrelated food chains*. Credit was also given for responses which indicated that the food web was *better able to show how one organism could occupy more than one trophic level or may have more than one source of food.*

Module 2

Question 5

Syllabus Objectives: 5.6, 5.4
Highest Mark: 15 Mean Mark: 6.6 Lowest Mark: 0

Synaptic transmission and functions of the human kidney were the main topics examined.

This question was fairly well done with approximately 25 per cent of the candidates gaining ten or more marks. For the first section of Part (a), the majority of candidates gained at least one of the two allotted marks. Unfortunately, some candidates confused *synaptic transmission* with propagation of action potential. In Part (a) (ii), the majority gained some marks and of these many were awarded full marks as they were able to state all of the steps in the *chemical transmission of an action potential across a synapse.* However, some candidates omitted key steps especially, for example, *the neurotransmitter diffuses across the cleft* and *the inflow of sodium ions causes depolarization of post synaptic membrane*. Also, a few candidates did not list the steps in the correct sequence.

Part (b) (i) was reasonably well done with many candidates gaining at least one of the two allocated marks for outlining at least one main function of the kidney, that is, either *excretion* or *osmo-regulation*. Candidates who simply stated two functions but gave no outlines were awarded one mark. Part (b) (ii) proved to be the most challenging for the majority of candidates, in particular the section which required them to explain how the *kidney accomplishes its functions by the process of 'secretion'*. Generally, for all three processes, candidates were unable to link the significance of the process with the main functions. In explaining *ultra-filtration* most candidates referred to *hydrostatic pressure, under pressure, pressure* or *create pressure* without actually stating *high pressure* as expected. The section on how *the kidney accomplishes its function by selective re-absorption* was quite well done, with many candidates gaining the maximum two marks.

Module 3

Question 6

Syllabus Objectives: 2.1, 4.5
Highest Mark: 15 Mean Mark: 4.45 Lowest Mark: 0

In Part (a) (i), candidates were required to explain the term *complement* and outline its role in the body's response to invasion by foreign organisms. Part (b) focused on an understanding of ways in which cigarette smoke may result in breathlessness and difficulty in breathing.

Generally, candidate performance for this question was found to be satisfactory. There was some discrimination between candidates who did very well and those who knew little on the topics of immunity and the effects of substance abuse, and thus gave poor responses. Part (a) (i) presented some difficulty for candidates. While many were familiar with the elements of an immune response, few were able to effectively relate this knowledge to the function of complement proteins in the process. Also, most candidates did not adequately explain the term *complement* as required in the question and therefore gained only one mark for simply stating that complement *consisted of proteins*. A few did mention that the *proteins were inactive* and even less referred to the *cascade of reactions*. Most candidates, who gained additional marks, were able to do so by outlining aspects of an immune response that involved complement such as *phagocytosis* and *opsonisation* of bacteria which dealt with the role of complement.

Part (a) (ii) was fairly well done and many candidates were able to obtain at least two of the three assigned marks. Some candidates were too general in their responses and did not link each aspect to how it occurred. Most of those who gained the marks were able to explain the inflammatory response and could state specifically how each aspect arose, such as the *increase in blood flow (vasodilation) at the infection site for redness, increase in production of phagocytes and their subsequent activities which increased metabolic heat for warmth and the 'leakiness' of blood capillaries at the site resulting in swelling.* Candidates are reminded to take note when terms are highlighted in bold or capitalized in the stem of a question as this is intended to guide them on how to approach the question to arrive at the expected correct response.

In Part (b), candidates appeared familiar with the general content on the effects of cigarette smoke on the body, though some were unable to make the direct connection of these effects to the appropriate disease. Also, some candidates were unable to focus on only those effects of smoking that would affect breathing, and thus dealt with addiction of nicotine or the formation of cancer due to tars. Good responses first referred to the cause of Emphysema as the *breakdown of the alveoli wall by elastase due to the presence of tars/particles, which leads to the reduction in surface area for gaseous exchange and the inability of the alveoli to efficiently recoil and stretch to accommodate fresh air, thus labouring breathing*; Bronchitis

being caused by *build up of particles along the respiratory tract that increases mucus production, narrowing the airways and damaging cilia and lungs leading to breathlessness.*

Paper 032 – Alternative to School-Based Assessment (SBA)

Question 1

Syllabus Objectives: 2.8
Highest Mark: 12 Mean Mark: 4.15 Lowest mark: 0

Overall, this question was not well done as most candidates scored less than 50 per cent of the allotted marks. For Part (a) (i), very few candidates were able to draw a diagram showing how the given apparatus and material could be assembled to determine the rate of oxygen uptake. Even when they successfully drew the diagram, they failed to annotate the labels. Part (a) (ii) was fairly well done as most candidates indicated that the rubber and glass connections must be airtight as a precaution. Many candidates restated precautions when asked to suggest one step that should be taken to ensure the reliability of the results of the investigation (Part (a) (iii)). Expected answers included *taking multiple readings under the same conditions for the same time* or *resetting the apparatus to ensure that the levels of the water in both manometers are the same before the start of the investigation*. For Part (a) (iv), the experiment required candidates to collect and use data to determine the amount of oxygen used by the germinating beans. Only ten per cent of the candidates were able to give an appropriate answer such as *use graph paper to record the initial and final manometer fluid levels* and to *calculate the difference to determine oxygen utilized.* Many candidates knew that the *small plant would carry out photosynthesis in addition to respiration.* However, they struggled to explain that the gases, carbon dioxide (needed for photosynthesis) and oxygen (produced by photosynthesis), would impact on the readings for Part (a) (v).

Question 2

Syllabus Objectives: 1.5, 3.2
Highest Mark: 15 Mean Mark: 9.95 Lowest mark: 5

This question tested candidates' knowledge of the structure and function of vascular tissue in plants and animals. Candidates performed well on this question with more than 70 per cent gaining at least half of the allotted marks. For Part (a) (i), some candidates were able to identify and adequately represent the vein, while others could not distinguish between the artery and the vein or represent the tissue using neat, clean lines in correct proportions. For Part (a) (ii), most candidates were able to get maximum marks for stating two observable differences between the artery and the vein.

Part (b) (i) required candidates to plot given data as a line graph. This part of the question was successfully done by most candidates. However, a few did not label both axes and failed

to use and/or state an appropriate scale. Part (b) (ii) proved to be the most challenging as only a few candidates gained full marks. Many were able to describe the trends but did not suggest a reason for the shape of the graph.

Question 3

Syllabus Objectives: 3.1
Highest Mark: 16 Mean Mark: 12.75 Lowest Mark: 8

This question presented candidates with data on the prevalence of obesity in children of some Caribbean territories and tested their ability to use and analyse that data. Almost all candidates successfully answered Parts (a) (i), (ii) and (iii). In Part (a) (iv), candidates were able to identify that *prevalence of obesity increased in each country and that the percentage increase in each country was different,* along with other trends. For Part (b) (i), candidates were able to identify that *St Vincent had the second highest prevalence of obesity in 1990* and that the increase in prevalence was the *least by 1999.* Many candidates were able to score full marks for discussing four reasons for the increase in childhood obesity in the Caribbean in Part (b) (ii). Few mentioned *inadequate breast feeding* or *early introduction of formula* or *solid foods* as a reason for childhood obesity.

General and Specific Recommendations for Teachers

Understanding of basic concepts is essential at this level and teachers must ensure that these are clearly identified and adequately taught. This is especially critical for certain topics, for example, ecology and evolution. While factual knowledge is important, such knowledge cannot be readily applied if there is little or no understanding of the basic concepts. Also, there is need to ensure that students are competent in the use of technical terms and can interpret information presented in a diagram or in graphical form. In addition, an understanding of rubric terms, for example, *comment* versus *discuss* or *outline* versus *explain* is critical to the quality of a response. Finally, the importance of mastering practical skills must be conveyed to students, as these skills will be examined in the final examination papers.

General Issues Concerning Paper 032

Inadequate preparation of candidates for this paper continues to be of concern.

General Comments on the SBA

Practical activities in the SBA laboratory books indicated a true practical approach with wide syllabus coverage. However, each skill should be assessed from more than one syllabus topic. There are still instances where schools are using outdated syllabuses and consequently the laboratory exercises selected for assessment, in some cases, were inappropriate. Teachers are still not completing the moderation sheets. Teachers are reminded to review the accuracy of

marks entered on the moderation form. Teachers should ensure that all moderation forms are completed accurately and that the scores entered for each skill coincide with those recorded in the students' reports. The two best laboratory exercises should be selected and the average grade entered for each skill. The exercise chosen for SBA moderation should be clearly identified, either in the mark scheme or in the table of contents. Teachers should be careful not to use decimals or fractions in the completion of the moderation forms.

Planning and Design (P/D)

Students are still presenting inappropriate laboratory exercises for P/D assessment. Selection of CSEC level and textbook laboratory exercises should be discouraged. Students did not write the procedure for P/D in an instructional format, but rather used continuous prose and reported in the past tense. Students should be encouraged to submit original work for the P/D activity. P/D experiments should not be copied from the textbook. All students in a given centre should not have the same hypothesis, aim, material apparatus and method.

Teachers are reminded to provide problem statements, questions or observations which allow students to design original laboratory exercises for P/D. Students should be instructed to investigate one variable at a time. The aim of the experiment should be very specific. Students should be given an observation which should be used to generate the hypothesis, aim and method.

A significant portion of students demonstrated that they did not have a clear understanding of what constitutes a proper hypothesis. The hypotheses stated were sometimes too lengthy. A control should be included as well as the specific quantities of substances to be used. Biological principles should be used in explaining predicted results.

P/D activities should reflect original and creative thoughts. While many laboratory exercises used adequate sample sizes, very few included repetition of the activity in the design of their method. Although some laboratory reports were well presented and organized, too many were of a low standard. Laboratory reports should be securely bound and properly labelled with a useful table of contents. Students should be encouraged to number the pages of the reports, and to use these in the preparation of the table of contents. Teachers are not totalling marks out of 12. While the quality of assessment by teachers has improved for some schools, overall the standard of marking was found to be lenient.

Analysis and Interpretation (A/I)

In general, students displayed weakness in their ability to analyse the data obtained in a practical exercise. Students need to link a biological concept to the observed results and should justify each trend observed. A concise conclusion relevant to the aim should be stated. Background theory must be included, and should not be too lengthy. Teachers are reminded that the use of drawings and electron micrographs for assessment of A/I skill is inappropriate.

Water potential, enzymes and osmosis or other physiology related topics can be considered as alternatives. Candidates failed to connect the biological principles with the results obtained. Also, they listed sources of errors as limitations; the difference was not clear as they were unable to distinguish between the two. Simple food tests confirming the presence of a nutrient are not recommended for the assessment of A/I. The background information should be directly related to the results from the experiments, and should be used in the interpretation and explanation of the results. It was evident that teachers made an effort to address the proper construction of a discussion, but there were weaknesses in the interpretation of the data and in addressing limitations and sources of error in the experiments.

Drawings

The quality of drawings, although improved, was still not at the expected standard. The magnifications were not calculated and recorded; titles did not display the view and name of the specimen being drawn; annotations were inadequate. Copies of textbook drawings continued to be included for assessment. Students should use the term *drawing of…* instead of *diagram of…* in their titles. Where magnifications were stated, many students neglected to include the formula and/or show calculations for magnifications. The misconception persists in assuming magnification refers to the power of the microscope used to observe the specimen. Magnifications should be calculated using the formula: *size of drawing divided by actual size of specimen.* Very few students produced drawings that gained full marks for clarity.

Plan drawings included cellular details. Students must be advised against including an excessive number of cells when recording cellular detail in a high power drawing. Three to four well drawn cells, in breadth and depth, will suffice. An improvement was seen in the faithfulness of reproduction and in the use of reasonable sized drawings. Approximately 50 per cent of the SBA samples presented drawings with label lines that were not justified. Some students have not been correctly instructed in the construction of label lines. Every effort should be made to ensure that label lines are parallel and neatly drawn with a ruler. Labelling in cursive should be discouraged. Labels should be in script only and in upper or lower case. One format should be selected and maintained for all labels and annotations, and for all drawings. Teachers and students are reminded that annotations are short descriptive notes about form or function of the labelled structure.