CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN SECONDARY EDUCATION CERTIFICATE JANUARY 2008

BIOLOGY

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GENERAL PROFICIENCY EXAMINATIONS

JANUARY 2008

GENERAL COMMENTS

Introduction

As customary the January 2008 sitting of the CXC examination in Biology consisted of four papers:
Paper 01 – Multiple Choice
Paper 02 – Structured Essay Questions
Paper 03 – Extended Essay
Paper 04/2 – Alternative to the School-Based Assessment

Performance of candidates in this examination showed many similarities compared with the performance in previous sittings of the January examination. Consequently, a similar number of candidates were able to obtain grades between I and III. However, there was a drop in the performance at the Grade I level in particular and there is adequate evidence to suggest that more attention must be paid to the comments and suggestions continuously offered by the Examining Committee. A relatively large proportion of the candidate population makes fundamental errors that prevent them from demonstrating their best efforts. The following comments and suggestions are ongoing and of critical importance.

- Candidates must improve their test-taking skills. This includes practice in reading questions carefully and planning responses so that answers are organized in a logical and coherent manner.

- Candidates continue to waste a lot of valuable time providing irrelevant information in the essays. They should focus on key words such as 'describe' and 'explain' when reading the questions and be guided by the mark allocation and quantitative descriptors within the text of the question as far as possible.

- There was also the question of choice of terminology and descriptions provided. Familiarity with biological jargon allows candidates the opportunity to express themselves more accurately and reduces errors caused by oversimplification.

- Candidates should pay more attention to the stimulus material provided in the questions, especially in Paper 02. The stimulus material is meant to guide the candidate to the expected responses. Too often candidates respond by providing obscure information on the topic that do not relate to the scenario presented.

- More emphasis should be placed on practical skills and the candidates' ability to demonstrate these skills in responding to questions on the Alternative to SBA paper. Too many candidates seemed unfamiliar with basic laboratory equipment and material and even the simplest of biological/scientific methods. Candidates demonstrated particular weakness in identifying precautions and limitations of an experiment, as well as in stating aims and formulating hypothesis.

- The spelling of common biological terms is generally so poor that candidates cannot be rewarded with marks. It is also difficult to explain why candidates would incorrectly spell biological terms used in the question.

PAPER 01 – Multiple Choice

Paper 01, consisted of 60 multiple-choice items. Performance on this paper was similar to that of last year's. Some of the topics that *continue to be* problematic for candidates were:

- Aspects of ecology including feeding relationships and food chains
- Cell structure and function
- Specifics of photosynthesis
- Specifics of respiration
- Cell specialisation
- Morphology of root, stem and leaf
- Phloem structure
- Reflex arc
- Aspects of nutrition, for example, role of different vitamins
- Aspects of respiration and excretion
- Joints
- The functioning of the pupil in the eye
- Metabolic rate and effect on the body temperature
- Distinction between meiosis and mitosis
- Distinction between population and community
- Sampling methods

PAPER 02 – Structured Essay Questions

Paper 02 consisted of five short-answer structured questions of which the first was the data analysis question worth 30 marks. This paper tested all profile skill areas identified in the Biology syllabus. Candidate performance on this paper declined in 2008 over 2007, with fewer candidates falling within the upper grade bands. However, once again there were no modes at the extreme lower end, that is, below 4.

Candidates were able to attain marks across the allotted range for all but two of the five questions. However, for more candidates to give their best performance attention must be paid to observations and suggestions the Biology examiners have repeatedly noted. In particular, candidate attention is drawn to the use of the stimulus material in responding to the questions and the guidance provided by the spaces allotted to each question – answers should relate to the stimulus material and should be kept within the allotted spaces. ***Candidates must note that they are not required to repeat the questions to begin their responses***.

Question 1

This question dealt with some practical aspects of Biology including interpreting graphs of enzyme activity, methods of obtaining data from an enzyme investigation and sources of error, as well as enzyme activity in softening meat. Candidates were also required to display their knowledge of the conditions necessary for germination and the role of microorganisms in natural cycles. Candidate performance on this question did not quite meet expectations.

Part (a) (i) required candidates to interpret a graph which showed a decreased rate of enzyme reaction in the first part and an increasing rate of reaction in the second part. This was not at all well done, and most candidates failed to gain the allotted marks. They generally gave the values indicated on the graph without recognizing that they were to refer to the reaction rate. In Part (a) (ii) in which candidates were expected to estimate the optimum temperature for the enzyme in the reaction, they also did not do very well. They did not seem to recognise that the optimum temperature for the enzyme would be that at which the fastest/ near the fastest rate of reaction took place, which will be reflected on the graph as the shortest time.

Part (b) asked candidates to represent the data shown in the graph on a table. Apart from the traditional errors made in constructing tables including the omission of the title and inappropriate headings, many candidates failed to correctly fill in the data, especially in terms of sequence and selection of the target values. This showed some of the confusion in reading the graph and unfamiliarity in distinguishing the *manipulated variable* from the *responding variable*. Too many candidates had the manipulated variable in the right-hand column.

Part (c) of this question which asked about an investigation involving the use of the enzyme amylase, was not very well done. In Part (c) (i), they were to identify the materials and apparatus and outline the method they would use and in Part (c) (ii), they were to identify one source of error. Candidates were expected to include apparatus such as *water-bath, thermometer, timer, white tile and a source of the enzyme* and include in their method means of *setting up the water-bath and maintaining its temperatures, preparation of the substrate, removal of experimental solution at intervals and use of iodine to detect starch* among other ideas. Sources of error would be obvious as *maintaining the temperature of the water bath, quantity of enzyme,* or *volume of drops removed at intervals*.

Part (d) of the question explored candidates' ability to cue into information provided to apply knowledge of how enzymes work. Part (d) (i) asked candidates to suggest what process might be taking place when meat is softened with green papaya. This part of the question was not well done as candidates failed to use the information in the trend of the question to help focus on the possibilities. Similarly, in Part (d) (ii) which asked candidates to suggest why if the crushed papaya is added to the meat while cooking, that the cooking time is not shorter, many candidates did not relate the results to denaturing of the enzyme due to exposure to high temperatures.

Part (e) of the question sought to examine candidates' knowledge of the germination process taking place within a seed. Performance on this part of the question was disappointing, since this is supposedly a well-known part of the syllabus. In Part (e) (i), candidates were to indicate two ways in which water helps the process of germination. Candidates were expected to refer to its role in: *enzyme activation, transport, reaction medium,* or *structural material*. In Part (e) (ii), candidates were expected to identify environmental conditions for germination. It is surprising that many candidates still identify 'sunlight' as an environmental factor for germination. It is thus reiterated here that the environmental conditions necessary for germination are *air (oxygen), suitable temperature* and *moisture (water).*

Part (f) of the question examined candidates' knowledge of microorganisms. Part (f) (i) asked candidates to identify microorganisms. Many candidates are unclear about what types of organisms qualify as 'microorganisms'. Candidates insist on naming the 'earthworm' as a micoorganism. In Part (f) (ii), candidates were asked to identify one cycle which depends on the activities of microorganisms. Most candidates were able to name the *carbon* or *nitrogen* cycle. However, when they were asked in Part (e) (iii) to explain the importance of the microorganism in a natural cycle, many candidates were unable to indicate their role in *breakdown of organic material, release of nutrients* or *recycle materials.*

Question 2

This question tested candidates' knowledge of gaseous exchange in plants and animals as exhibited in examples of freshwater snails and the pondweed. Candidates were required to predict and explain the results of an investigation that was set up with the organisms in various test tubes based on likely colour changes of a carbon dioxide indicator. Candidates were also expected to suggest what changes may have occurred in the environment to cause the sudden death of pond snails. Performance on this question was fairly good with candidates earning marks across the entire range available from 0 to 14.

In Part (a), candidates were asked to identify experimental tubes with different colour changes and explain their responses. This part of the question was fairly well done. By and large they recognised that a tube with the snails would most likely have more carbon dioxide produced by respiration, while one with the pondweed would have reduced levels of carbon dioxide because of photosynthesis.

In Part (b), candidates' were required to identify the control tube (i) and explain the purpose of wrapping one of the tubes in foil. This part of the question was fairly well done.

Part (c) asked candidates to suggest what changes may occur in the environment to cause the sudden death of the snail population in the pond. This part of the question was not at all well done. In many cases candidates provided explanations that were not related to the context of the question. Expected responses that were rarely given included: *pollution; reduction in oxygen supply/eutrophication; introduction of predators;* or *loss of food source.*

Question 3

This question assessed candidates' knowledge of blood circulation through the heart and to the heart muscles as well as how thickening of the coronary arteries may occur. Candidates were also required to explore their knowledge of transport in plants. Generally, candidates performed within the range of expectation as shown by a mean of 9.5 out of 17 marks and a mode of 7. Candidates attained scores right across the range on this question, but the vast majority attained scores between 6 and 17.

Part (a) of the question tested candidates' knowledge of blood flow through the heart. In Part (a) (i), candidates were required to illustrate using four arrows only, the flow of blood through the heart. This part of the question was fairly well done, although candidates often confused the names of the vessels leading to and from the heart as shown in the response in Part (a) (ii). Part (a) (iii), which was fairly well done, required candidates to explain how having a 'hole in the heart' may affect its functioning when the atria contract. Candidates were expected to focus on: *mixing of oxygenated and deoxygenated blood; reduced efficiency in blood carrying capacity;* or *need for the heart to work harder/ strain on the heart.*

Part (b) investigated candidates' knowledge of blood transport to the heart muscles. This part of the question was well done. In Part (b) (i), candidates were to name two substances that blood transports to heart muscle cells. In Part (b) (ii), they were to identify one substance transported in the blood that could cause the walls to thicken. The expected response was *cholesterol* or *plaque*. Candidates at this level are expected to provide the more obvious response, which garners full marks. In Part (b) (iii), candidates were asked to explain how the thickening of the wall of the coronary artery affects the heart. A good response would have included aspects of: *blocking/reducing flow of blood; reduction of size of lumen; inadequacy of supply of nutrients to heart; inability to deliver adequate blood supply; resulting in a heart attack/infarction.*

Part (c) examined candidates' knowledge of transport in plants. This part of the question was fairly well done. Candidates were generally able to identify the xylem and phloem. However, far too many candidates confused what was transported by the different tissues. Some felt that xylem transported both 'water and food' or that phloem transported 'food and nutrients'. It should be noted that the xylem transports *water* and *mineral salts* and that the phloem transports *manufactured food/sugars*.

Question 4

This question examined candidates' knowledge of the processes of meiosis and mitosis, as well as cloning. It also tested candidates' knowledge of the development of the ovule into the seed. Candidate performance on this question was disappointing, although there was general familiarity with the topics, and candidates were able to gain marks across most of the spectrum from 1 – 14 out of 16. A few candidates were unable to gain any marks at all. The mode was 5.

In Part (a), candidates were to distinguish between the processes of meiosis and mitosis. In Part (a) (i), candidates were required to distinguish between diagrams illustrating the differences in the processes; in Part (a) (ii), they were to identify differences between the processes and then name specific locations in plants where these processes occurred in Part (iii); then provide reasons why both types of cell division are important in the plant for Part (iv). Although this topic was familiar to the candidates they often interchanged the processes and this shows the need to emphasize the differences between these types of cell division. Candidates should note that *meiosis produces 4 daughter cells per division compared with 2 for mitosis; meiosis results in reduction division while the genetic number is maintained in mitosis; meiosis produces non-identical gametes while mitosis produces identical daughter cells.* Candidates often failed to identify that mitosis occurred in the *meristems* found in the *root tip* and *shoot tip* or the *cambium*, while meiosis produced *pollen in the anthers* and *ova in the ovaries.* In responding to Part (a) (iv), candidates were to indicate one of the following for the importance of meiosis: *for maintaining the diploid number of successive generations; introduction of variations into the species; better adaptability to changing environmental conditions; gamete production/halving the chromosomes number*. They were to consider one of the following for the importance of mitosis: *growth/producing similar types of cells; repairs of tissues; rapid production of clones/offspring in favourable conditions; taking advantage of favourable conditions.* Part (b) of the question was fairly well done. It asked candidates about cloning and the possible advantage and disadvantage. Candidates were initially required to identify the process of *cloning* from a written description provided in Part (b) (i). They were then required in Part (b) (ii) to suggest one advantage and one disadvantage of the process. Candidates were expected to select from these advantages: *retain/pass favourable characteristics;* and from the following disadvantages*: long term effect not fully known; aging of clone may be faster; attempt to clone humans*.

Part (c) dealt with candidates' knowledge of the development and structure of the seed. This part of the question was very badly done. More than half the candidate population did not know that the *ovule* developed into the *seed*, which was the expected response for Part (c) (i). As much as ninety percent of the candidate population could not give two features of the seed which was required in response to Part (c) (ii). Candidates were expected to identify features such as: *the seed bears a single scar; possesses cotyledons, contains the embryo, found within the fruit* and so on.

Question 5

This question tested candidates' knowledge of the nitrogen cycle and the relationships, mutualism and commensalisms. Candidates were able to gain marks across the entire spectrum from 1 to 13. Performance on this question was reasonable although it was expected that candidates would be more generally familiar with the processes involved in the nitrogen cycle. Candidates seemed to most easily access the marks in the parts of the question that dealt with mutualism and commensalism.

Part (a) was presented in the form of a stylized nitrogen cycle from which the candidates' knowledge of the topic was examined. Part (a) (i) of the question asked candidates to name the processes carried out by bacteria that occur at identified points on the diagram. Candidates performed very poorly on this part of the question. Some seemed unfamiliar with the processes and others, who were familiar with the terminology, were confused by the process. Candidates were expected to identify in sequence: *nitrogen-fixation, denitrification, decomposition and nitrification.* Part (a) (ii) asked candidates to explain how nitrates from the soil become protein in plants and animals. Candidates were expected to refer to: *plants absorb nitrates from the soil; nitrates used to synthesized proteins in the plants; plants eaten by herbivores; herbivores by carnivores; plant proteins/amino acids used by animals to make animal proteins.* This was fairly well done, although many candidates did not recognise a sequence to the process of incorporating nitrogenous compounds by plants before being accessed by animals through feeding. Part (a) (iii) required candidates to explain why the relationship between legumes and the bacteria in their root nodule was considered mutualistic. Candidates needed to explain the benefits derived by both organisms from the relationship and sometimes this was not done. Candidate performance on this part of the question was fair. They were expected to include in their responses: *both organisms benefit from the relationship – the legumes obtain nitrates from the activity of the bacteria; legumes can thus grow in soils depleted of nitrogen; bacteria obtain in the relationship some nutrients/shelter.*

Part (b), which asked candidates to identify types of relationships other than mutualism, was well done. Candidates were expected to refer to: *commensalism, parasitism; predator/prey relationships* and were often able to provide appropriate examples.

PAPER 03 – Extended Essay

Candidates' performance on this paper was consistent with their performance in January 2007. Candidates demonstrated a continuing ability to write at length about biological events, principles and concepts. However, sometimes candidates missed key words in the questions and provided answers which were off the point. It is thus reiterated that candidates should be advised that *the reading time should be used to **read** through each question carefully, highlighting key words on which the questions hinge, so that they would be less likely to misread and misinterpret questions*. ***The reading time should also be used to plan their responses so that they are more likely to stick to the relevant topics***. It is clear that much time is spent on teaching and learning the content of the syllabus. However, more attention needs to be paid to developing important examination techniques which will allow candidates to make the best use of what they know.

Question 1

Candidates selected this question more frequently than they selected its counterpart, Question 2. This question required knowledge of the excretory functions of the body and the structure of a uriniferous tubule. In addition, this question tested candidates' knowledge of the effects on the liver of alcohol abuse, as well as their general knowledge of drug abuse. Candidate performance on this question was unexpectedly low, with the vast majority of scores within the lower half of the mark range.

Part (a) examined candidates' knowledge of excretion. In Part (a) (i), candidates were asked to identify two substances produced by the body that can attain toxic levels. Most candidates knew of at least one substance. Many candidates were not specific enough and included 'nitrogenous waste' instead of *urea*. In Part (a) (ii), candidates were to explain with the aid of a diagram how the kidney tubule is able to reduce toxic levels of a substance in the body to harmless levels. Candidates generally knew how urine is produced, but were often unable to relate the production of urine to reduction of the levels of urea in the body. They often failed to include in their responses: *continual filtration; toxic substance in filtrate, the removal of a little more of the toxic substance with each volume of blood filtered in the kidney*. Many diagrams were also poorly drawn.

Part (b) dealt with candidates' understanding of the damage that can be done to the liver through alcohol abuse and the impact on the functioning of the liver. Most candidates were able to gain some of the marks in this section. However, candidates needed to convey that: *alcohol abuse can lead liver damage/ cirrhosis; build up of toxicity; poisoning/death, in addition to malfunction and improper metabolism of a range of substances*. Several candidates provided specific examples of liver functions for example, 'production of bile', 'conversion of glucose to glycogen' and deamination of protein' but did not make the link to damage to the liver.

Part (c) examined candidates' knowledge of drug abuse. In Part (c) (i), candidates were to suggest reasons for increased drug abuse. This part of the question was fairly well done. Candidates were able to provide expected responses including: *availability, accessibility, thrill/pleasure seeking* and *peer pressure.* In Part (c) (ii), they were required to suggest ways in which prescription drugs might be abused, and to suggest likely long-term effects. Candidates performed fairly well on this part of the question, although they failed to include the wide range of possible responses and sometimes their responses tended to be somewhat vague. They were expected to refer to: *not taking the full dose of prescription; stop taking drugs before course is finished; taking old/ leftover drugs; too frequent administering of drugs.* Long-term effects expected to be referenced included: *resistance by user to drug; loss of effectiveness; pathogens develop resistance; new strains become more virulent; more difficult to treat.* Too many candidates still made the mistake of saying that the pathogen will become 'immune' rather than *resistant*.

Question 2

The question required a description of the stages in the life history of an insect vector, reasons for continued outbreaks of vector borne diseases and methods of protecting the body from contracting infectious diseases. Candidate performance was surprisingly weak as they seemed challenged by many parts of the question. Scores ranged from 1 to 14 with only one candidate gaining above 14.

In Part (a) (i), candidates were asked to describe, with the aid of a diagram, the stages in the life history of a named insect vector of disease and in (a) (ii) to suggest why vector borne diseases still occur in spite of knowing the life histories of the vector. Candidates performed poorly on Part (a) (i). They showed a surprising lack of accurate knowledge of the life history of an insect vector. They interchanged 'larva' and 'pupa' and used terms like 'baby mosquito' to describe the *larva* and *pupa*; *pupa* became 'pupil' and *imago* became 'embryo'; and incorrect descriptions were given to the pupal and larval stages. Very few candidates gave the expected responses such as: *larva as the feeding and growing stage; pupa as the stage of internal development and re-organisation; the adult as the reproductive stage* or *stage for distribution of species since they have wings.* For Part (a) (ii), candidates gave better responses. They focused on *improper hygienic practices* and *lack of education*. However, their responses could have included other suggestions such as: *other human activities such as travel; pathogens mutate; unavailability of medicines to the poor; vectors not eradicated; knowledge of life history helps to control spread, not cure disease.*

In Part (b) (i), candidates were asked to explain the principles involved in taking a course of vaccines. This part of the question was not well done. Even though a 'course of vaccines' was explained in the stem as "more than one dose over time", many candidates gave responses that did not address the question, stating 'some vaccines are taken annually', '… every five years' or '… once in a life time'. When the question was correctly interpreted, candidates displayed fair knowledge of the principles involved in taking vaccines. They included in their responses some of the following: *antibody production stimulated by antigen; small dose of weakened antigen initially; for subsequent infection, antibodies already present/ memory; rapid response subsequently; more antibodies made.* In Part (b) (ii), candidates were required to suggest why the principles of vaccination do not work for all infectious diseases. This part of the question was not well done, principally because of the loose use of biological terminology. Candidates must understand that they cannot be rewarded when biological jargon is used incorrectly. In particular, the terms 'adapt' and 'immune' were inappropriately used in the majority of cases. Some candidates claimed that 'the influenza virus adapted to the person', while others said 'the person was immune to influenza'. Candidates were expected to frame their responses around the following ideas: *viral antigens may change frequently; rapid mutation; new antibodies required each time infection occurs; bacterial infections are best treated with antibiotics*.

Question 3

The question tested candidates' knowledge of the structure and function of the human female reproductive system and birth control methods, as well as their views on the control of the size of human populations. This was by far the more popular of the questions in Section B of the paper. Candidate performance on this question was quite satisfactory. Marks were obtained in the range from 2 to 20. No candidate obtained a score of 0 or 1 in this question and a number obtained full marks. The mode was high at 13.

Part (a) asked candidates to (i) describe the structure of the human female reproductive system, and (ii) explain how the reproductive system was suited for its function in reproduction. Most candidates were able to draw a reasonable diagram of the female reproductive system, although a very large number had no idea of the spelling of the various parts. Terms such as 'ovary', 'ovum' and ovule' were used interchangeably in Part (a) (i). In Part (a) (ii), instead of explaining how the system was suited for its functions, several candidates described the process of sexual reproduction. Candidates were expected to construct their responses to include: *ovaries produce eggs/hormones; oviduct/fallopian tube transports the egg/site of fertilisation; uterus houses the embryo/protects the embryo; cervix can dilate to expel the baby; vagina is the birth canal/accepts the penis.*

Part (b) of the question explored candidates' knowledge of contraceptive methods. In Part (b) (i), they were asked to explain how tubal ligation could prevent pregnancy without stopping the monthly period. This question was well done. Most candidates gave an appropriate explanation, although some candidates thought that tubal ligation would prevent the development of the egg. A good response was:

> Although tubal ligation prevented the sperm from reaching the egg and preventing fertilisation, the monthly period is controlled by hormones which travel in the blood so this process would not be affected.

Part (b) (ii) asked for three other birth control methods. This was very well done. Most candidates were aware of at least three additional methods of birth control.

Part (c) of this question focused on the control of the human population. In Part (c) candidates were asked to (i) suggest reasons why control of the human population is necessary, and (ii) explain whether or not government should decide on the number of children a couple should have. Candidate performance on this part of the question was fair. In Part (c) (i), many candidates were able to provide suitable reasons for controlling the size of the human population. Candidates were expected to include in their responses some of the following*: humans depend on natural resources; there is a limit to these resources; population must not outstrip resources; human population subject to the same limitations as other animal populations.* A good response was:

> There are limited resources. More people may bring more pollution and there would be need to build more houses which would mean cutting down more trees.

In Part (c) (ii), candidates were rewarded for answering, either in the affirmative or negative, once the response was appropriately supported. Candidate performance on this question was good. Candidates responding in the affirmative were expected to refer to: *limited resources; government provision of social amenities; government's responsibility to protect the environment.* Candidates responding in the negative were expected to refer to: *size of family a matter of personal choice; erosion of individual rights; possible upset of overall gender balance; religious/cultural belief/traditions.*

Question 4

Only one in approximately ten candidates selected this question. The question examined candidates' knowledge of the structure of a dicotyledonous seed and the role of its constituents in growth and development. Candidates' were also asked to explain the roles of selected hormones in human growth and development and to predict results of a genetic cross. With fewer that sixty candidates attempting this question the statistics may have little value. However, performance on this question was satisfactory, with a mean of approximately 8. Scores were achieved across the spectrum from 0 to 20 and they were bimodal at 4 and 12.

Part (a) asked candidates to describe, with the aid of a diagram, the internal structure of a dicotyledonous seed. This part of the question was fairly well done, although several candidates included external structures such as 'testa' and 'scar'. Some drew the internal structure of a leaf. In Part (a) (ii), candidates were asked to explain the role of the parts of the dicotyledonous seed in growth and development. This part was fairly well done. Candidates were expected to include in their responses: *the cotyledons – provided food, were the site of conversion of stored food and translocation to the embryo, site of enzyme activity; embryo/plumule and radicle formed the seedling.*

Part (b) sought to explore candidates' knowledge and understanding of the role of hormones in growth and development in animals. In Part (b) (i), candidates had to identify two hormones involved in the process. Most candidates were able to give two examples, but some candidates gave the organ of production rather than the hormones and failed to gain the marks allotted. In Part (b) (ii), candidates were to suggest why there should be concern about the diet of young children which included products from animals treated with hormones. This part of the question was not at all well done. Candidates failed to relate the possible absorption of hormones from food to growth and development issues in young children. Instead, they tended to focus on dietary issues like the lack of nutrients and obesity. Candidates were expected to include in their description a coherent account based on: *excessive hormones stimulate development; secondary sexual characteristics develop earlier than normal; long-term ill effects.* A good response to this part of the question was:

> Excess hormones in a young child can lead to certain adolescence features developing before they are supposed to.
> It can also affect the long-term health of a young child because of too rapid growth and development.

Part (c) asked candidates to explain, with the use of genetic diagrams, how it was possible for a goat breeder to obtain large offspring. The majority of candidates attempting this question used symbols inappropriately. They did not seem to understand that the desired offspring was large and reference was to a simple monohybrid cross. The symbols were selected for a large ram and high reproducing female rather than for large ram and normal or small female. Some thought that large size was sex-linked and others lost marks as they skipped steps in the genetic process, for example, they went from parents to F_1 generation without showing gametes. Where candidates did not make these errors they were able to gain full marks for this part of the question. A good response was:

> L – dominant (large)
> l – recessive (small)

The large male would have a genotype LL. If the female has a genotype ll, then the cross in the genetic diagram shows the offspring genotype.

Female / **Male**	**l**	**l**
L	Ll	Ll
L	Ll	Ll

Ll – all the goats would be large since L is dominant over l. The desired results are obtained.

Question 5

This was by far the more popular question of the pair in Section C, attracting almost two-thirds of the candidate population. The question required knowledge of decomposers and their role in the carbon cycle. They were also expected to use knowledge of occurrences in the carbon cycle to account for global warming and the possible negative and positive effects of this phenomenon. Candidate performance on this question was fair. The mean for the question was approximately 5 and the mode was 7. Candidates had great difficulty accessing marks in the upper ranges with no candidates scoring more than 15 marks.

In Part (a) of the question candidates were required to define decomposers, explain their role in the carbon cycle and explain characteristics they possess to fulfill their role. Candidate performance on this part of the question was fair. They were generally able to provide a definition of 'decomposers' (Part (a) (i)), but few were able to explain their role and adaptations. In Part (a) (ii), candidates were expected to include in their responses the following ideas: *decomposers recycle nutrients from dead bodies/ organic matter/ waste/ urine; carbon compounds absorbed/ incorporated by organism; carbon dioxide returned to the atmosphere during respiration; carbon in waste materials recycled.* In Part (a) (iii), candidates still made the error of identifying earthworms as decomposers. It is again reiterated that decomposers are *bacteria* and *fungi.* The characteristics that these organisms possess that make them effective decomposers are as follows: *absence of chlorophyll; inability to manufacture food; they secrete enzymes; they digest organic matter to obtain nutrients; many capable of anaerobic respiration; breakdown carbohydrates in low oxygen conditions.*

Part (b) asked candidates to explore their knowledge of the carbon cycle in relation to various phenomena. In (b) (i), candidates were asked about the benefits of greenhouse conditions to plants. Candidates did not perform well on this part of the question. They were expected to use their knowledge of what occurs in a greenhouse that cause plants to flourish, which should relate to conditions that would promote growth in plants. They were thus expected to include in their response ideas such as: *high temperature increases rate of photosynthesis; high humidity restricts transpiration; starch is formed faster/more food available; plants thrive.* In Part (b) (ii), candidates had to suggest reasons why global warming is not desirable for animals. This part of the question was also not well done. Candidates were often only able to access half the available marks. They were expected to consider that *elevated temperatures increase the rate of water loss/desiccation of small invertebrates; affected the environment, for example, destruction of habitats/melt ice caps, alter periods of rainfall/drought; cause natural disasters – hurricanes, tsunamis, tornadoes, flooding; lead to increasing poverty, hunger, loss of life.* A good response to this part of the question was:

> … when global warming occurs the temperatures can become too high for animals because they are not built to adapt quickly to major climate change. There is also the destruction of their habitat, such as, the melting polar ice caps that reduce the habitats of polar bears and threaten their food supply.

Part (b) (iii) asked candidates to suggest one way in which global warming might be advantageous. Many candidates were able to provide a reasonable response, including: *warming of cold countries making them more temperate; increase in crop yield in some countries.* A well thought out response was:

> … winter might no longer be very cold or even exist allowing plants to grow all year through without problems of shortage of supply of food.

Question 6

This question required knowledge of the importance of wetlands and the negative impact of human activity on them. Candidate performance on this question was fair with a mean of approximately 6 and a mode of 6, although few candidates obtained the higher scores and no one got full marks.

Part (a) investigated candidates' ability to apply their general knowledge of ecology to a particular habitat. In part (a) (i), they were asked to give reasons why wetland ecosystems are of great importance. Candidate performance on this part of the question was fair. Candidates showed little knowledge of the importance of wetlands, which should be of concern to them especially as Biology students. Some even interpreted the terminology as 'wet land' and consequently did not address wetland issues. A number mentioned wetlands and tourist attractions. However, in addition, they were expected to include among their suggestions the following concepts: *wetlands are nurseries for fish, crustaceans; habitats for birds; reduce pollution through treatment of effluent; reduce damage to coastlines during hurricanes/storms; protect against loss of life.* In Part (a) (ii), candidates were to suggest ways in which human activity could affect a wetland ecosystem. Candidates performed fairly well on this part of the question. They recognised the potential for pollution and destruction of the wetland from a range of human activities. Candidates were expected to include the following ideas in their responses *housing/commercial developments; road/highway construction; burning mangroves for coal; dumping non-biodegradable waste material; hunting/ killing wildlife/reducing biodiversity.*

In Part (b) (i), candidates were required to suggest reasons why indiscriminate garbage disposal should be discouraged. Performance on this part of the question was weak. Candidates generally seemed to believe that the garbage itself cause disease and bacteria. It should be noted that to gain the available marks candidates had to make the link with the garbage harboring disease vectors. Candidates were expected to frame their responses using ideas like: *garbage attracts vectors of disease; provides food for disease-causing organisms, for example, houseflies; attract scavengers; are unattractive/bad for image of the community/country.* In Part (b) (ii), candidates were asked to suggest means, other that posting signs, to encourage proper garbage disposal. This part of the question was well done. Candidates considered factors such as 'education', 'increased numbers of garbage bins in prominent places', 'charging fines for littering'.

Part (c) required candidates to present an argument, from the perspective of an environmentalist, against the use of inorganic fertilisers. This part of the question was not very well done. Candidates simply indicated that inorganic fertilisers were 'harmful' but did not say in what ways and to which organisms. Candidates were expected to include in their responses: *these fertilisers easily leach into water; contribute to death of aquatic life; affect the pH of the soil/waterways; increase nutrients in water, leading to eutrophication; causes algal bloom which reduces availability of oxygen to other organisms; facilitates soil erosion.*

PAPER 042 – Alternative to the SBA

This paper assessed all the practical skills required of biology students. Candidates continue to display weak practical skills, especially in aspects of planning and designing including manipulating and describing methods of experiments and in drawing conclusions from data. It is thus re-iterated that these observations suggest that teaching for developing practical skills *must include actual experimenting and investigating scientific phenomena, discussions, explanations and rationalizing of procedures and outcomes on the* part of students so that they become capable of developing and manipulating experiments and experimental data on their own.

Question 1

This question tested a range of candidates' experimental skills including classifying organisms (from drawings), presenting data, and investigating organisms in a specific habitat. Candidates were also required to make a drawing of a fish gill from a photograph and relate the structure of a gill to its function. Candidate performance on this question was reasonable although very few attained top scores. Candidates displayed weak skills in classifying organisms and were often unable to describe a method for investigating organisms in leaf litter. The mean for this question was approximately 11 out of 27 marks available, while the mode was also 11.

Part (a) required candidates to demonstrate the skills of Observing/Recording/ Reporting, Measuring and aspects of Planning and Designing. In Part (a) (i), candidates were to identify three characteristics that they observed in drawings of six organisms that could be used to classify them. This question was generally well done by candidates, although their spelling and or interpretation of *antennae* were at times quite atrocious. They referred to 'antlers' 'anthenas', 'antenas' and a host of other variations. Part (a) (ii) asked candidates to construct a key, table or chart to show how the characteristics identified would distinguish among the organisms. This question was fairly well done. Several candidates were able to organise a table to distinguish the organisms. Part (a) (iii) was not very well done. Too many candidates thought that they could use a quadrat to investigate the number and types of organisms in a leaf litter habitat. Candidates were expected to describe the use of: *traps/bottles, Tullgren funnel* or some *means of sifting through the leaf litter.* They were also to include in the description of the method of their investigation *counts/ estimates of per unit area; identification/ classification procedure;* and *repeats*. Few candidates were able to give a precaution in carrying out the investigation, required in Part (a) (iv), but could provide at least one safety precaution for which they were rewarded. In Part (a) (v), candidates were to construct a table to show how data collected by the method described in (a) (iii) would be recorded. This was a very poorly done part of the question. Candidates failed to gain what could be described as easy marks. They were to include in their table the following characteristics which are the normal requirements of a table for recording field data: *appropriate headings, appropriate columns that include one for numbers; neatly boxed with appropriate title*. Part (a) (vi) was fairly well done. Several candidates gained full marks in this section as they were able to provide sound reasons for the leaf litter to be considered a good habitat for the organisms identified in this question. Where candidates were unable to gain the marks in this section they seemed not to realise that there were biological reasons for the organisms to be attracted to the habitat and it was not simply because they 'liked' the environment. Candidates were expected to indicate that the *leaf litter consists of decaying leaves which provided a ready food source for small herbivores; created a favourable micro-climate; reduced desiccation; provided shelter from predators.*

Part (b) (i) of the question, which required drawing of a fish gill from a photograph of a dissected fish head and knowledge of the structure and function of the gill, was not very well done. Candidates generally ignored the rules of drawing including guidelines for clarity and accuracy and thus failed to gain the allotted marks. Part (b) (ii), which required the magnification of the drawing, was also not well done. There were two problems, the first, in calculating the magnification (some candidates guessed as much as 1000 times) and the second, in representing the magnification. The conventions for these must be observed to gain the mark allotted. Note that the magnification must be written with 'x' in front of the value. Part (b) (iii) asked candidates to explain how the structure of the gill is suited to its function. This was poorly done. Candidates held a number of misconceptions about the breathing apparatus of the fish and how breathing takes place. They feel that the 'fish takes in air', that 'the operculum is the breathing apparatus' and that the 'gills filter the water'.

Candidates were expected to include in their responses that: finely divided filaments increase surface area and absorption; copious blood supply for efficient uptake of oxygen; gill rakers which are sturdy, form barrier for protection of delicate filaments; and secretion of mucous for trapping particles.

Question 2

This question tested the candidates' ability to use graph paper to determine the areas of two different types of leaves, explain the importance of leaf area and how a plant might compensate for having leaves with small areas. Candidate performance on this question was good with a mean score of approximately 10 out of a total of 17 and a mode of 9.

In Part (a) (i), candidates were required to draw the two leaves with which they were provided on the graph paper. This question was fairly well done with most candidates obtaining at least half the available marks. It was heartening that few candidates shaded their drawings although there were some obvious challenges to the candidates. Too often their drawings showed untidy lines of uneven thickness; no magnification included; leaf stalk not drawn as directed and no distinguishing features seen between the two specimens. In Part (b), candidates were to identify three differences observed between Specimen A and Specimen B. Candidates scored poorly on this part of the question. They seemed not to know the external structure of the leaf. They seemed unfamiliar with terms like *apex, margin, leaf stalk/petiole*. Candidates did not recognise that while Specimen A had a network of veins, Specimen B had parallel veins. Many claimed that Specimen B had no veins. Also, when asked to compare, candidates tended to give a feature in one leaf and failed to say what obtained in the other leaf for that feature. It is reiterated here that a comparison must be made of the same feature in the two organisms being compared to qualify as a comparison. Part (c) was very badly done. Candidates were asked to calculate the leaf area of the two leaves. Many candidates did not recognise that the reason why they were asked to draw the leaf on the graph paper was to facilitate the estimation of leaf area, and all they were required to do was to count the number of square centimetres, compensating for the irregular shape of the leaves. Some candidates measured the length of the leaf down to the tip of the petiole and multiplied by the width of the lamina at its widest part. Other candidates counted the millimetre square which would have taken an inordinately long time and was not necessary. In Part (d) (i), candidates were asked to explain the importance of leaf area to the plant. This part of the question was well done. Responses that failed to gain full marks were often those that did not link the functions of the leaf to the area of the leaf as required by the question. A good response was:

> The larger the leaf area, the more surface of the leaf is exposed to air and sunlight, allowing maximum absorption of sunlight and carbon dioxide for photosynthesis, making more food.

In Part (d) (ii), candidates were asked how a plant might compensate for having small leaves. This part was also well done. However, some candidates appeared to have lost marks because they did not understand the term 'compensate', while a number of others referred to 'reduction of transpiration rate' and 'development of longer roots to obtain water', and some even made wild statements like the 'plant obtains food from the soil'. Good responses included: *by producing numerous leaves, growing taller to maximize exposure of leaves to sunlight; having more chloroplasts; obtaining food from other plants, that is, becoming parasitic*.

Question 3

This question tested the candidates' ability to represent data from a field study on water loss in two plant species. Candidate performance on this question was good although no candidate obtained full marks. The mean was approximately 10 out of 16 and the mode was 10.

Part (a) of the question required candidates to draw a pair of graphs to represent data collected on water loss in two plant species Candidates performed fairly well on this question and generally plotted the points correctly, although a number of them made several errors. Errors observed included: *use of incorrect axes, absence of a title, untidiness, absence of a key.*

In Part (b), candidates were to identify sources of error in the investigation. This part was fairly well done. A good response was: *error in measuring the plant due to faulty scale; error in timing the hourly intervals …*

Part (c) required candidates to explain the differences observed in water loss in the two plant species. Candidate performance on this question was only fair. Candidates were expected to determine that Species Q lost water faster than Species P and this might relate to the suitability of the species to different environmental conditions. Good responses were as follows:

> Species P might have been a plant adapted to an environment containing little water supply while Species Q might have been from an environment with an abundant supply of water, therefore it is not adapted for water loss.
>
> Q loses more water than P because maybe Q has more stomata or the stomata of Q may be larger. Species Q loses more water than P, therefore the transpiration rate level in Q is more than in P.

Part (d) required that candidates illustrate, using a diagram, how the apparatus provided (a string, weighing apparatus, a plant and a sheet of clear plastic) could be used to collect the data provided in the table. Apart from poor drawing skills already discussed in relation to Questions 1 and 2, few candidates were able to correctly illustrate the arrangement of the apparatus. The plant was often drawn with the part above the soil wrapped in the sheet of plastic and the plastic with water positioned on the scale; and the string in the wrong position. Candidates were expected to show the plant positioned on the scale and the *plastic wrapped around the pot and tied with the string at the base of the plant*, just above the soil.