CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2010

BIOLOGY

GENERAL COMMENTS

The CAPE Biology examination comprises three papers based on each unit covered in the syllabus. Paper 01, a Multiple Choice paper, consists of 45 compulsory items (15 from each of the three modules. Paper 02 consists of six compulsory questions (two from each of the three modules) and Paper 03/2, an alternative to the Internal Assessment, is taken by candidates who do not register for the Internal 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 was worth a total of 15 marks. Each question on Paper 03/2 was worth 16 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

Overall performance on Paper 01 was generally good for both units. While performance was fairly even across the modules, candidates continued to be challenged by items based on genetic variation and natural selection (Unit 1) and to a lesser extent, with items testing knowledge and understanding of water potential. An unexpected finding was the fact that candidates seemed to have some difficulty in distinguishing between pulse (rate) and blood pressure. Since the concepts related to those topics are fundamental to Biology, it is essential that greater emphasis be placed on ensuring that all candidates have a sound understanding of these topics.

UNIT 1

Paper 02 – Structured/Essay Items

Section A – Structured Items

Module 1

Question 1

Syllabus Objectives: 1.8, 4.1, 4.2, 4.4
Highest Mark: 15 Mean Mark: 5.62 Std. Dev: 2.88

This question was designed to test candidates' knowledge of the basic structure and functions of proteins as well as their understanding of the properties and functioning of enzymes. Despite the straightforward nature of the question, the majority of candidates failed to score high marks; only two were able to gain full marks. Many candidates lost marks because of an inability to provide clear explanations for expected points.

Part (a) (i) required candidates to list four functions of proteins in living organisms. Most candidates were able to list at least one or two functions. However, many gave responses such as enzymes or hormones without indicating the functions, for example, enzymes – accelerating biological reactions. Other acceptable functions include structural support and transport. For Part (a) (ii), candidates were asked to circle the peptide bond in a diagram of a dipetide molecule. Many candidates incorrectly circled the region of the C=O and/or the N-H bonds in addition to the C-N peptide bond and were therefore unable to score the one mark. A small percentage of candidates were unable to identify the peptide bond. Part (a) (iii) proved more challenging than expected, as many candidates were unable to correctly illustrate the amino and/or carboxyl groups; in some cases, bonds were omitted.

Part (b) (i) asked candidates to state one property of enzymes that relates to their structure and one that relates to their main function in the cell. While candidates appeared to be familiar with properties of enzymes, many were unable to distinguish between a structural property versus one which is functional. The sketching of the curves for Part (b) (ii) was poorly and untidily done despite the guides provided in the given figure. Another error noted was a misconception as to whether the presence of an enzyme increased or decreased the amount of energy needed for the reaction to progress.

Part (c) (i) proved difficult and was also poorly done. Candidates were unable to accurately describe the trend observed for each graph. For Part (c) (ii), some candidates incorrectly identified the types of inhibitions shown in the graphs or used inappropriate terms, for example, continuous. An appropriate response should read:

> *Graph A shows competitive inhibition because with increasing concentration of the substrate, the rate of reaction was slower in the presence of an inhibitor but the same maximum rate of reaction was attained.*

Module 2

Question 2

Syllabus Objectives: 2.1, 2.2, 2.6, 2.5, 2.6
Highest Mark: 15 Mean Mark: 8.67 Std. Dev: 3.32

This question examined candidates' knowledge and understanding of mitosis and meiosis. Part (a) examined candidates' ability to recognize three key stages in mitosis, as illustrated in the figure and to evaluate whether, based on observation of features shown, a candidate could describe a characteristic feature for each stage. Most candidates obtained at least three out of a maximum of six marks for identifying the stages. The expected responses were: A – Prophase; B – Anaphase; and C – Telophase. Many candidates were able to correctly state a characteristic feature for each stage. Despite the good performance, it was noted that terms were incorrectly used, for example, for Anaphase chromosomes instead of chromatids. Teachers should ensure that misconceptions are addressed.

In Part (b), candidates were expected to draw the arrangement of chromosomes during Metaphase I of meiosis. Generally, this was not well done as drawings were either unclear or incorrect as to the number of chromosomes that should be drawn. The majority of candidates obtained at least one of the three allocated marks based on the fact that they were able to show the position of the chromosomes at the metaphase plate. A common misinterpretation was to represent mitosis instead of meiosis, hence many candidates did not show two homologous pairs of chromosomes, show the sister chromatids in the form of tetrads or distinguish between a homologous pair (maternal and paternal) by the shading or stripping of one member of the pair.

Part (c) was fairly well done with a majority of responses obtaining two out of a possible three marks. Some candidates did not seem to understand the term 'ploidy'. The last feature listed in the table proved difficult for candidates to obtain full marks. A precise phrase was required, so for mitosis this was 'genetically identical' to parents and each other. Candidates incorrectly wrote 'similar' which does not imply having the same genetic composition.

Part (d) proved the most challenging. Many candidates did not attempt this part of the question. It was expected that for (d) (i), they would have been able to name the process which chromosomes undergo prior to nuclear division, that is, replication/duplication of DNA. Similarly, the stage should have been easily identified as Interphase. Part (d) (ii) asked candidates to state one reason why the process named in (d) (i) was necessary. Providing a correct response — maintaining genetic stability — proved difficult for many. Other acceptable responses included *condensation allows for pairing, alignment or separation of chromosomes*.

Module 3

Question 3

Syllabus Objectives: 3.4, 3.5
Highest Mark: 15 Mean Mark: 7.0 Std. Dev: 3.03

A good knowledge of the structure of human sperm and ovum was key to answering question three.

For Part (a) (i), candidates were asked to identify four structural regions of the sperm, highlighted in the figure, to attain two marks. Many were able to accurately identify all four regions, that is, tail, middle piece, neck and head. Some candidates confused the sequence of the regions and thus gave incorrect identifications; others gave inappropriate names, for example, mid-rib, lamella.

Part (a) (ii) was generally well done by the majority of candidates. Again, some candidates did not seem to understand the term 'ploidy' and gave answers such as 'n' instead of stating the term 'haploid'. Clearly, the teaching of this concept needs some attention. The majority of candidates were unable to give two reasons to account for the presence of a large number of mitochondria in the sperm. While many were able to relate this to the supply of energy for the sperm to swim, few, if any, related this to the long distance which the sperm must travel in order to fertilize the ovum.

Part (a) (iv) was not well done as some candidates failed to recognize the acrosome as being a lysosome and to correctly describe its function as releasing hydrolytic enzymes to digest the outer layers of the ovum.

Part (a) (v) was well done with many candidates giving secondary oocyte as the correct response. However, drawing of the secondary oocyte, as required for Part (a) (vi), was poorly done. Approximately 40 per cent of the candidates failed to present an appropriate drawing with appropriate annotations. A major failing was providing functional annotations and not annotations giving structural details of the ovum as stipulated. Teachers are reminded that annotations are notes that accompany a label and are not restricted to functional details.

Part (b) examined key differences between ovum and sperm. This was well done and many candidates were able to gain full marks. Similarly, Part (c) was well done.

Section B – Essay Items

Module 1

Question 4

Syllabus Objectives: 2.3, 2.6, 3.2
Highest Mark: 15 Mean Mark: 6.28 Std. Dev: 3.94

This question focused on two aspects of cell organization, one being the chemical composition of cell membranes and the other a comparison between prokaryotic and eukaryotic cells.

For Part (a) (i), candidates were required to name five chemical components of the cell membrane and state a function for each. Approximately 70 per cent of candidates gave satisfactory responses. Several, however, seemed unclear about what was meant by 'chemical components' and wrote about chemicals such as oxygen, carbon and water. Average responses listed four to five components but were unable to provide a complete list of functions. A common error was a description of the nature of the components, for example, hydrophilic phosphate head of a phospholipid, rather than functions.

Part (a) (ii) was generally well done, and many candidates who performed well on Part (a) (i) also did well on this part of the question. Weaker candidates wrote on transmembrane protein or simply protein and did not make the distinction between a carrier and a channel protein. In some instances, candidates confused the functioning of a channel protein with that of a carrier protein. An acceptable response was *the carrier protein shape can change (ping state to pong state) to allow for movement of materials' or 'the channel protein has a fixed shape with a hydrophilic pore which allows passage of specific ions (polar molecule)*.

For Part (b) (i), about 25 per cent of the candidates did not seem to understand that the question, as stated, required them to only distinguish between the terms 'prokaryotic and eukaryotic'. Many of them stated differences which did not relate to the meaning of the terms. Hence, responses to this part of the question overlapped with what was expected for Part (b) (ii). Simply stating that 'prokaryotes do not have a true nucleus while eukaryotes do have a true nucleus' would have gained two marks. A small percentage of the candidates (15%) gave one of the expected answers for Part (b) (ii) in Part (b) (i) and therefore were unable to score any marks for that particular point. Nonetheless, at least 20 per cent of the responses received five of the six allocated marks and approximately five per cent achieved the full score. Some candidates seemed not to know that photosynthesis in prokaryotes occurred on special membranes called lamellae and simply stated that prokaryotes did not have chloroplasts.

Question 5

Syllabus Objectives: 4.1, 4.2, 5.3, 2.4
Highest Mark: 15 Mean Mark: 4.76 Std. Dev: 3.53

The overall performance on this question was less than satisfactory as topics such as genetic variation and mutation continued to be challenging for candidates.

Part (a) (i) was generally well done. Candidates were awarded one mark for stating 'a variety of genotypes in a population'. Candidates were knowledgeable about the sources of variations and gave good explanations of 'crossing over' but were weaker in attempting to explain 'independent assortment'.

For Part (a) (ii), many candidates were able to clearly define mutation as '*a change in the DNA of a cell*' but several failed to state that both gametes and somatic cells were the cells in which mutations occur.

Good responses were noted for Part (a) (iii) and candidates gained two marks for simple explanations of deletion and substitution, for example, deletion '*involves loss of a nucleotide in a triplet*' while substitution '*involves the replacement of a nucleotide in a triplet*'. Discussion of the statement was not well done and the connection between the mutation and consequences of potential changes in amino acid sequences was not addressed. Teachers are encouraged to place greater emphasis on covering the concepts related to this topic.

Given the nature of the poor responses for Part (b), it is clear that candidates did not have a sound knowledge of genetic engineering, in particular the role of restriction enzymes in bacterial cells. Many candidates were of the opinion that restriction enzymes cut bacterial cells. However, a few candidates did seem to understand that the role of restriction enzymes in bacterial cells was to protect the cells, 'restricting' foreign DNA, for example, viral DNA that enters the cell, by destroying it. At least one mark was awarded if a candidate indicated that restriction enzymes 'recognize and cut specific sequences in double-stranded DNA'. Despite the apparent lack of understanding that biologists can use restriction enzymes to cut a stretch of DNA from the genome of one organism and paste it into the genome of another, some candidates were able to obtain some marks for Part (b) (ii). Again, teachers must ensure that basic principles are well explained as outlined in Objective 4.1.

Module 3

Question 6

Syllabus Objectives: 2.6, 2.7, 2.8
Highest Mark: 15 Mean Mark: 5.08 Std. Dev: 4.44

This question tested candidates' knowledge and understanding of plant reproduction.

Part (a) was reasonably well done and the majority of candidates were able to score at least three or four out of a possible six marks. In some instances, definition of pollination was incomplete or not at the expected level. Some misconceptions were: pollen falling from the male part of a plant onto the female part or pollen being transferred to the style or pistil. An acceptable answer is: '*Pollination is the transfer of pollen grains from the anther to the stigma*'. Most candidates seemed to have a sound understanding of the events which lead from pollination to fertilization. However, some lost marks for not presenting the information in the correct sequence.

About 60 per cent of the candidates were able to score at least two marks for Part (b). Marks were lost for not mentioning the fusion of two polar nuclei (secondary nucleus) with one of the male gametes to form the endosperm, as well as the more obvious point of fusion of one male gamete with the female gamete to form a zygote. Candidates were awarded one mark for any one significance

stated. A few candidates gave clear definitions of double fertilization in Part (a) but failed to repeat the information in (b) where it was required.

The performance for Part (c) was noticeably better as approximately 80 per cent of the candidates demonstrated a clear understanding of the question and scored from four to six marks. A few candidates misinterpreted the question and gave explanations of the ovary and zygote for humans.

Paper 03/2 - Alternative to Internal Assessment

Module 1

Question 1

Highest Mark: 13 Mean Mark: 8.27 Std. Dev: 3.43

Generally this question was reasonably well done, with approximately 30 per cent of the candidates attaining scores ranging from 11 to 13 marks.

For Part (a), most candidates were able to score at least 50 per cent of the marks for constructing the table to show the results of an investigation of the effects of potato extract on varying concentrations of catechol. However, some omitted to include the title of the table. The table lines were well drawn and columns were named accurately in 70 per cent of the cases. A gradual intensity of colour as the substrate concentration increased was rarely stated.

In Part (b), many candidates did not gain full marks for suggesting a specific aim for the experiment, as they neglected to mention that it was an investigation of 'varying' substrate concentration on the rate of the reaction or product formed.

For Part (c), the relationship between substrate concentration and enzyme activity was accurately stated by most candidates, but there was *no reference to the intensifying colour changes* that determined the relationship.

Commentary on the purpose of Tubes 4 and 5, Part (d), was poorly answered as candidates did not determine that there was no substrate present in Tube 4 and no enzyme present in Tube 5 and that these tubes acted as controls for the experiment.

Part (e) asked candidates to identify one limitation. This was not well done as only ten per cent of the responses identified a limitation. The fact that the experiment required a qualitative assessment of colour which was subjective to visual observation and determination seemed to elude candidates.

In responses for Part (f), candidates suggested that the colours needed to be accurately determined, only a few mentioned the use of the colorimeter which could be used to convert the colour absorbance values into quantitative data.

Part (g) was generally well done as most candidates stated factors such as temperature, pH and presence of inhibitors or enzyme concentration as those that can affect the state of an enzyme catalysed reaction.

Module 2

Question 2

Highest Mark: 15 Mean Mark: 6.53 Std. Dev: 3.96

Responses to this question were generally fair with about 50 per cent of the candidates gaining scores ranging from seven to ten marks.

For Part (a) (i), most candidates accurately stated the ratio of 1:1:1:1 for the test cross of the red-flowered, short stemmed F_1, generation phenotypes from red-flowered, short stemmed and yellow-flowered, long stemmed parents. However, very few gave adequate reasons to explain why the F_1 progeny were phenotypically alike as required for Part (a) (ii). Some accurately suggested that red colour and short stem were dominant to yellow colour and long stem, but omitted the point that the parents are pure-breeding or homozygous for the trait.

In Part (a) (iii), candidates were asked to explain the ratio obtained from the cross of the F_1 generation plants. Very few stated that the four alleles were situated on different pairs of chromosomes or that the two genes were not linked. An accurate and complete diagram of the test cross (RrSs x rrss) would have been awarded full marks but was rarely seen.

Part (b) was based on two histograms showing the effect of ozone and ultraviolet radiation on the growth of pollen tubes in two plant species. In Part (i), candidates were asked to describe and explain the common trends in the data. Many candidates recognized that ultra violet (UV) and ozone reduced the growth of the pollen tube for both species of plants but failed to mention that the nature of the retardation was different for each inhibitor and each species of plant. For Part (ii), candidates were expected to compare the effects of each treatment on *N. tabacum* and *P. hybrida.* Expected answers were:

- Ozone reduced pollen tube growth and the effect was greater in *N. tabacum* than in *P. hybrida.*
- UV radiation inhibited pollen tube growth approximately the same for both plants, but with a slightly greater effect in *P. hybrida.*
- The combination of ozone and UV radiation was greater than any single factor for both plants, but with a slightly greater effect on *N. tabacum.*

In Part (ii), candidates were required to suggest two sources of error when interpreting the results of the experiment. Many accurately stated the discrepancies in accuracy of pollen tube length due to small size and also the inability to deliver ozone and UV radiation consistently and accurately.

In Part (iv), most candidates accurately explained that ozone and UV radiation could impact negatively on a plant by reducing the chances of fertilization. This would also impact on the seed/fruit development and eventually limit the continuation of the species.

Module 3

Question 3

Highest Mark: 16 Mean Mark: 5.71 Std. Dev: 4.48

Overall this was not a high scoring question, with only one candidate gaining full marks.

Part (a) was based on a slide of a transverse section of an anther prior to dehiscence. In Part (i), candidates were required to make a detailed annotated diagram of one of the pollen sacs seen in the specimen. Most drew the entire anther with the four pollen sacs but few gave a good diagram of the correct region. A drawing with clean continuous lines and of reasonable proportions and size was seen in many cases. Few candidates gave appropriate annotations. Calculation of the magnification, Part (a) (ii), was poorly done as few candidates were able to accurately calculate the magnification of the drawing given. Teachers are reminded of the importance of teaching this skill. Many candidates correctly described the appearance of the specimen after dehiscence, that is, the pollen sac would not be continuous, the pollen grains would be scattered or the fibrous wall would be ruptured after dehiscence.

In Part (b) (i), candidates were required to make a plan drawing of a section of the human ovary to show four key stages in the development of the Graafian follicle up to ovulation. Many produced drawings of clear continuous lines with no shading or unnecessary detail, and of reasonable proportion. However, very few were able to show any of the stages, which included the germinal epithelial, primordial follicle, primary follicle, secondary follicle, Graafian follicle (mature) and Graafian follicle (ruptured). Perhaps having a question only testing drawing skills and doing so twice proved to be too demanding.

Again, very few candidates were able to calculate the diameter of the mature Graafian follicle observed; a value approximately 1–2 µm depending on material would have been an acceptable answer for Part (b) (ii). For Part (b) (iii), few candidates were able to state the presence of the antrum or oocyte attached to the follicle wall by stalk as an observable distinguishing feature of a mature Graafian follicle.

UNIT 2

Paper 02 – Structured/Essay Items

Section A – Structured Items

Module 1

Question 1

Syllabus Objectives: 1.1, 3.5
Highest Mark: 15 Mean Mark: 8.78 Std. Dev: 3.68

This question tested candidates' knowledge of chloroplast structure in relation to photosynthesis.

For Part (a) (i), the majority of candidates were able to score at least three of the four allocated marks despite the fact that many drawings were below the expected standard. Less than 25 per cent of the responses showed good drawings. Many omitted the double membrane or did not annotate the drawing as instructed.

Part (b) (ii) was generally well done. Approximately 80 per cent of the candidates were able to gain three of the four allocated marks. Marks were lost for inadequate descriptions of the structure of the thylakoid and/or granum as they relate to photosynthesis.

Part (b) was fairly well done. Candidates were required to identify various processes in the nitrogen cycle. However, in some instances, candidates seemed not to understand the difference between assimilation and absorption and used the terms interchangeably. Some gave descriptions of the processes when they were asked to only identify the processes.

Parts (b) (i) and (ii) proved to be challenging as most candidates were unable to describe two ways by which nitrogen is lost from soil ecosystems. Many gave only one way. Similarly, many were unable to describe two human activities which impact on the nitrogen cycle for Part (b) (iii).

Module 2

Question 2

Syllabus Objectives: 1.5, 2.1
Highest Mark: 15 Mean Mark: 6.73 Std. Dev: 2.88

Overall, performance was fair. Good answers were noted for Part (a) (i), despite the fact that many candidates were unable to explain all four precautions.

For Part (a) (ii), some candidates were unable to correctly state that the lower surface was the region where water loss will be greater. Identifying the factors — light, wind, temperature, humidity — that affect the closing and opening of stomata was well done but providing an explanation of how these factors caused stomata to open or close was not as well done which resulted in a loss of marks for Part (b).

Despite the clarity of the photomicrograph of a companion cell and sieve tube, several candidates were unable to correctly identify these structures for Part (c) (i). For Part (c) (ii), candidates were asked to discuss two structural differences between these two cells and to describe how or why despite these differences they function as a unit. This was generally not well done and there was some indication that candidates were unclear about what was required. A good answer should have included: '*A single tube (Y) has no nucleus, ribosomes, cytoskeleton but a companion cell (X) does. Y is dependent on X for support, energy for movement of sugars and amino acids*.'

Naming a route by which substances move from chloroplast in leaves to the phloem, such as symplast or apoplast should have been easily answered but some incorrect answers were found for Part (c) (iii).

Module 3

Question 3

Syllabus Objectives: 1.1, 1.2, 1.3, 4.5
Highest Mark: 15 Mean Mark: 7.82 Std. Dev: 2.47

Overall, performance was fair. In order to gain full marks for various sections, detailed information was needed and this proved to be quite challenging especially for candidates with poor writing skills.

Those candidates who could give a basic definition of health (Part (a) (i)) and distinguish between pairs of diseases (Part (a) (ii)) gained full marks. Candidates lost marks for failing to state that, for infectious diseases, organisms were transferred from one host to another. Part (a) (iii) was not well done and very few candidates gained full marks. Many candidates clearly did not understand that protein–energy malnutrition could be classified in more than one category and gave vague answers.

Part (b) proved to be even more challenging and many candidates either confused the graph lines or did not understand how to discuss the curves. For Part (b) (i), some marks were awarded for correctly describing trends, supported by data from the graphs, as part of the discussion. Greater attention and emphasis should be given to teaching the skill of interpreting graphs, especially with respect to describing observable trends. This is perhaps best done in practical exercises. Candidates were able to suggest two fairly good reasons for the difference in the shape of the curves but some lost marks for simply stating differences, some of which were covered in Part (b) (i), rather than suggesting reasons.

Part (b) (iii) was perhaps the most well done section of the entire question as any reasonable and well explained challenge was acceptable, such as addictive nature of smoking, absence of legislation to ban cigarette smoking or lack of funding for education programmes, detection or treatment.

Section B – Essay Items

Module 1

Question 4

Syllabus Objectives: 1.4, 2.2, 2.6
Highest Mark: 15 Mean Mark: 8.01 Std. Dev: 3.27

Two topics, glycolysis and photosynthesis, were examined in this question. Part (a) (i) tested candidates' understanding of the term 'glycolysis' and knowledge of where in the cell glycolysis occurs. Good responses were able to secure full marks for including in the explanation that '*the glucose molecule is split and converted into two molecules of pyruvate*' and that it occurred in the cytoplasm of the cell. Marks were lost for omitting key aspects of the process, such as not indicating that the glucose molecule is split or converted into two molecules of pyruvate.

Part (ii) was generally well done with many candidates being able to attain the full score of four marks. The majority of candidates cited as one reason the fact that the equation did not represent '*the several steps involved in cellular respiration, such as glycolysis, Kreb's cycle, link reaction, electron transport chain*' or the total amount of energy used and released. Other acceptable reasons included '*no indication of electron transfer aspects*' or the fact that '*enzymes and other molecules such as FAD and NAD*' are involved in the process. Some candidates discussed anaerobic respiration as opposed to aerobic respiration as required.

Parts (b) and (c) were generally well done. Many candidates were able to explain the role of photosynthesis as being 'to trap or absorb light energy' and even specified the wavelengths. Some further explained that when an electron gains energy it is 'excited'. The excited electron is then transferred to another molecule (called a primary electron acceptor). In commenting on the significance of ATP and $NADPH_2$ in photosynthesis, candidates gave an excellent range of responses, for instance, ATP as a source of energy and the reducing power of $NADPH_2$ — both supported by examples. It was reassuring to see that candidates did have a sound understanding of this aspect of photosynthesis.

Module 2

Question 5

Syllabus Objectives: 4.4, 6.1, 6.4
Highest Mark: 15 Mean Mark: 6.07 Std. Dev: 3.19

Part (a) of this question tested the structure of a motor neurone and synaptic transmission. For Part (i), candidates were required to demonstrate their knowledge of the structure of a motor neurone by doing an annotated diagram. Overall, candidates were able to do a fairly good diagram but did not do as well with respect to the annotations. Many gave functional notes rather than notes about the structure of the neurone. This meant that only a small percentage of responses were able to gain full marks; some credit was given if structures were correctly named. A few candidates incorrectly gave diagrams of a sensory neurone or a synapse.

Part (a) (ii) was not as well done because most candidates were unable to apply their knowledge of synaptic transmission to answer the question as asked. While some marks were awarded for explaining how acetylcholine functioned at the synapse, failure to mention that a build-up of acetylcholine in the synapse resulted in continuous generation of nerve impulses, and thus muscle stimulation, contributed to a loss of marks.

Part (b) (i) dealt with a comparison of nervous and hormonal control. Many candidates were unable to clearly outline two differences and gave partially correct responses. Of particular concern is the fact that the majority of candidates failed to recognize that nervous control involved both electrical and chemical transmission.

For Part (b) (ii), many candidates gave detailed explanations of the functioning of insulin rather than focusing on the ways in which a malfunction in insulin activity could lead to disease.

Module 3

Question 6

Syllabus Objectives: 2.2, 2.4, 2.7
Highest Mark: 15 Mean Mark: 7.87 Std. Dev: 4.13

This question tested candidates' knowledge and understanding of immune response and immunity. Part (a) was well done with most responses giving an appropriate definition such as '*defence reactions to invading organisms or foreign material*'. In distinguishing between cell-mediated and humoral responses, many candidates correctly stated that '*cell-mediated responses involved T cells which are directly involved in the elimination of antigens compared to humoral responses which are due mainly to the activities of B cells producing antibodies*'.

Discussion of the maturation of B and T cells was fairly well done in Part (b). The majority of candidates were able to state that B cells mature in the bone marrow or spleen compared to T cells which mature in the thymus. However, not all were able to fully discuss the maturation in relation to their specific roles, for instance, B cells circulating in the blood and lymph and transforming into plasma cells on exposure to antigens, or T cells transforming into cytotoxic cells or producing cytokines to destroy antigens.

Part (c) was also well done with many candidates being awarded full marks for stating that

> ' *a sample of a woman's urine is tested for the presence of human chorionic gonadotropin **(**HCG**)** hormone which is produced by the placenta and is usually only present in a woman's body when she is pregnant. Anti HCG monoclonal antibodies, produced commercially from a single cell line, are used in the test kit and these will bind to HCG if present in the urine sample. A positive reaction is indicated by a colour change in the test strip*'.

Part (d) proved to be the most challenging for some candidates despite the simplicity of the topic. Most candidates were able to explain that active artificial immunity was due to '*the administration of weakened or attenuated antigenic material (vaccines), therefore artificial, which stimulated the recipient's immune response to produce antibodies, hence active'*. However, explanations of passive artificial were not as clear, as many candidates failed to either include the fact that antibodies were

harvested from other individuals and injected into the recipient or did not mention that there was no stimulation of an immune response. In differentiating between the two types of immunity, some candidates did mention that 'one could result in long-term immunity whereas the other did not'.

Paper 03/2 - Alternative to Internal Assessment

Question 1

Highest Mark: 14 Mean Mark: 7.00 Std. Dev: 4.42

For Part (a), most candidates were able to formulate a suitable hypothesis for the designed experiment. '*An increase in temperature will cause an increase in oxygen uptake'*, was the most popular response. Candidates accurately wrote a suitable aim to match the hypothesis such as: 'To investigate the temperature on the rate of oxygen uptake in germinating pea' for Part (b).

For (c) (i), few candidates were able to make a good drawing of the experiment set-up. Each boiling tube (one with dead peas and the other with respiring peas) should have been attached to a manometer with a calibrated scale. Also, the tube with the respiring peas needed to be heated using a Bunsen burner.

Very few candidates were able to outline exactly how the experiment would be conducted in (c) (ii). Equal quantities of dead and respiring peas should be used and manometers set to the same level by using spring clips. At each experimental temperature, the respiring peas were left for five minutes to equilibrate before reading and recording from the manometer. The procedure should be repeated for at least three different temperatures within the 10^{o} C and the 35^{o}C range. The procedure should be written in present tense and a control using dead peas included in the design.

For (d), very few candidates suggested that precaution must be taken when setting up the experiment so as not to touch the soda lime with bare hands or that the water bath temperature should be monitored. The prediction (e) that an increase in temperature will result in an increase in oxygen consumption was almost always written by the candidates.

Lastly, few candidates were able to design an appropriate table to show how the results could be presented. The title was often omitted and the units of measurement were seldom seen.

Question 2

Highest Mark: 14 Mean Mark: 8.22 Std. Dev: 4.74

For Part (a), candidates were required to make a labelled plan drawing to show accurately the shape of the section of a mammalian kidney (L.S). Most candidates scored the marks for the shape of the kidney, continuous lines of even thickness and the tissue regions drawn proportionately. However, the title and magnification were rarely given. The label lines should be straight, parallel and drawn with a ruler. The fibrous capsule, cortex, medulla and pelvis were at most times labelled accurately.

For (b), the structures of A (sieve plate), B (sieve tube element), C (companion cell) and D (phloem parenchyma cell) were identified accurately by most candidates (the parenchyma cells to a lesser extent). For each structure, its main function was correctly stated.

Question 3

Highest Mark: 16 Mean Mark: 11.11 Std. Dev: 3.26

Candidates were required to summarize data on mortality rates for breast cancer in women. Most candidates accurately identified Uruguay as the country with the *highest* mortality rate, quoting data from the table (44.6%), for Part (a) (i). In (ii), most candidates accurately commented on the overall trend for the Caribbean in comparison to the North American countries. The data showed that Caribbean countries had a lower mortality rate for breast cancer and that, except for Cuba, there were increasing rates over the study period. Many candidates accurately suggested improved treatment and early detection as possible explanations for the decrease noted for Canada and the USA.

For (b) (i), many candidates were able to score full marks for the construction of a bar chart to display data given in a table. However, the title was omitted very often and the graph space given was not put to good use. The axes were labelled correctly and the bars accurately drawn.

The incidence for the period 2000–2005 was calculated accurately by almost all the candidates (Part (ii)).

Incidence rate = no. of new candidates/no. reported for the period = 20,000/40,000
Ans. 0.05

Candidates were required to suggest two possible reasons for the increase in the number of Dengue cases reported for the period in Part (iii). Many accurately stated that there was an increase in population size, travel, rainfall, urbanization and vector population. Also noted was the fact that there was deterioration in public health services.

General and Specific Recommendations for Teachers

In covering the syllabus, teachers must ensure that basic concepts are emphasized. While factual knowledge is important, such knowledge cannot be readily applied if there is little or no understanding of the basic principles. The absence of such understanding is evident in the poor responses to questions requiring some critical thinking. Greater emphasis must be placed on linking practical skills and exercises to the theory covered. Too often, candidates score poorly because of a weakness with respect to certain practical skills, for instance, being able to draw a graph or describe an observable trend.

General issues for Paper 03/2

- Concerns were expressed about inadequate preparation at centres for the practical examinations with respect to the availability of appropriate materials and equipment, for example, slide specimens, solution for experiments, functional microscopes.

- Provisions should be made to ensure that private candidates have access to facilities which would allow some training for practical exercises.

General Comments on the Internal Assessment

Overall, the quality of candidates' practical/laboratory assignments has improved tremendously since 2009. Several of the teachers at the centres are ensuring that a high standard is maintained by their students as it relates to their Internal Assessments. The improvements seen were in the generally weaker areas of Drawing and Planning and Design. It must be noted that authentic and novel Planning and Design (P and D) exercises were being used more often than textbook replicates.

However, despite this pleasing trend, there are still areas of concern. These include the poor formulation of hypotheses and related aims. In several cases, too many variables are being tested at once, thus creating difficulty in producing a relevant and appropriate aim. Finally, there were still some cases where the laboratory exercises used were inappropriate for the skill(s) being assessed. Research projects if used for P and D assessment need to adhere to the CXC/CAPE P and D guidelines when constructing the mark schemes.

It is suggested that territory workshops, focusing on local standardization of teachers responsible for Internal Assessment, be implemented. This is regarded as key to ensuring that candidates are provided with all the necessary tools to produce work of a high quality. Teachers are reminded that each laboratory exercise/ experiment should be used to assess only two skills at any given time. A pair of laboratory exercises can be used to provide the average score for each skill. Despite this, teachers must reinforce the standards expected by including several other experiments for each skill area, that is, A and I, DR, P and D, ORR and M and M.

Teachers are reminded that the awarded score along with constructive feedback must accompany each assignment/laboratory exercise marked. Feedback affords students the opportunity to improve further assignments.

Finally, the mark awarded for the assignment must be clearly shown and presented out of a score of 12. This facilitates more efficient moderation.

Drawings

There is still great concern in this area of assessment. Some teachers have allowed students to submit textbook drawings as their own original work. It is important that students produce true representations of specimens/slides with which they are provided. Reproduction of drawings in textbooks is not appropriate for assessment of drawing skills.

The following should be borne in mind regarding the assessment of drawing.

- Clarity of drawing.
- A selection of cells that is truly representative of the section being viewed.
- A low power plan of the tissues and high power details of a **few** representative cells should be done for each specimen. There is no need to attempt to draw all the cells seen.
- Faithfulness and accuracy in recording the drawing.
- Correct proportions of all components of the specimen are pivotal.
- Title must be placed at the base of the drawing, in uppercase and underlined.

- The view must be stated in the title, where applicable, for example, L.S (Longitudinal Section)/Whole Mount.
- Neat placement of labels and annotations.
- Justification of labels to the left, right, or evenly distributed on either side of the drawing is expected.
- Magnifications **must** be calculated and all working shown. The correct size of the specimen needs to be used in the calculation.

Insistence on these areas will afford candidates the opportunity to score highly in this area of Internal Assessment.

Analysis and Interpretation

Areas for immediate improvement highlighted by Examiners for 2010 are as follows:

1. Including adequate background information.
2. Deducing trends and relationships from data collected.
3. Presenting concise explanations of the observed trends and relationships.
4. Understanding the relationship between data obtained and the original aim/hypothesis of the experiment.
5. Formulating a conclusion that summarizes the findings from observations and data (with reference to the link between data collected and the aim) is essential. Generally, conclusions were of poor quality because the aim of the experiment was poorly designed.

Planning and Design

This year, the major challenge was in the area of conceptualising and formulating testable hypotheses from a stated problem.

Over the years, students have found the evaluation of this skill to be somewhat challenging. However, with continuous reinforcement of criteria, candidates should be able to grasp these concepts:

- Hypotheses need to be logical and testable.
- Aims must be concise and clearly stated.
- A complete list of all materials and apparatus to be used must be stated. Items critical to the execution of the proposed method should not be omitted.
- Methods/Procedures need to be in instructional/point form.
    - A control is essential and should be evident in the method proposed; simply identifying the controlled variable is not enough.
    - Repetition of the procedure under identical conditions is needed to ensure accuracy.