CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2011

BIOLOGY

GENERAL COMMENTS

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

The modules in each unit are:

Unit 1

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

Unit 2

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

DETAILED COMMENTS

Paper 01 – Multiple Choice

Overall, there was some improvement in performance for both units. More than 50 per cent of the candidates gained above average scores for Unit 1 and about 65 per cent for Unit 2. Less than 15 per cent of the candidates were awarded low scores for Unit 1 compared to 10 per cent for Unit 2. For Unit 1, there was a decrease in performance in the highest grade band; however, there was an increase in performance for most of the other grade bands.

A difference in performance in the modules was observed with the highest mean score recorded for Module 1, followed by Module 2, with a further decrease for Module 3. With respect to Unit 2, a marked increase in the performance in the highest grade band was noted, including a few candidates attaining full scores. The best performance was seen for Module 3 which had the highest mean score, followed by Module 1 and then Module 2 which had the lowest mean score.

Items based on genetics continue to challenge candidates. This is so even for basic concepts. For example, a clear understanding of ‘test cross’ ratios for dihybrid inheritance was not evident even among the more competent candidates.

UNIT 1

Paper 02 – Structured/Essay Items

Section A – Structured Items

Module 1

Question 1

Syllabus Objectives: 2.4, 2.5, 2.6, 3.3
Highest Mark: 15 Mean mark: 6.86 Lowest mark: 0

Parts (a) and (b) tested candidates' knowledge of the basic structure of prokaryotes and eukaryotes, as well as similarities and differences between animal and plant cells. Part (c) examined candidates' understanding of water potential for which candidates were required to outline an experimental design using potato.

Overall, the question was generally well done with a few candidates attaining almost full marks. However, performance was found to be average for the majority of candidates. The fact that the question was subdivided into several sections, each carrying a few marks, may have allowed candidates who were less familiar with the subject material to access some marks.

In Part (a) (i), some candidates did not recognize the diagram as being that of a prokaryote and mistakenly identified structures belonging to a human male gamete. The presence of a prominent flagellum on the figure may have contributed to this mis-identification as a few candidates referred to the flagellum as a tail. Despite these errors some candidates gave fully correct answers for the designated labels.

Despite the simplicity of Parts (a) (ii) to (a) (iv), not all candidates were able to give correct answers especially for Part (a) (ii) where simple differences were expected, for example, *cell walls contain murein in prokaryotes compared to cellulose in eukaryotes.* Parts (a) (iii) and (iv) were fairly well done, with many candidates giving the correct answer as *animal cells* for (a) (iii) and *mitochondria* for (a) (iv). Incorrect answers for Part (a) (iv) included lysosomes, golgi apparatus, chloroplasts and other organelles. Part (a) (v) seemed to be more challenging as several candidates did not attain full marks. Candidates seem not to understand that in stating a difference a clear comparison, giving differences for *both* cell types, is needed. When reviewing question rubrics with students, teachers must emphasize this point.

Overall, Part (b) was reasonably well done, with at least 70 per cent of candidates giving a correct answer for the first feature. However, for the second and third features many candidates did not seem to know that in plant cells the *central vacuole* is important in removing foreign matter and that *plasmodesmata* allow for communication between adjoining cells. Despite the straightforward nature of Part (c) (i), many candidates were

unable to clearly outline a simple investigation and hence few attained full marks. This weakness was also noted in the Planning and Design exercises for the School-Based Assessment. Candidates did not gain full marks because they failed to mention the use of more than one strip per solution, the need for a standardized time, that strips should be of equal size, the need for a control, among other things. It is obvious that the importance of reproducibility and reliability in an experimental design is not clearly understood.

The concept of water potential continues to be a challenge as several candidates were unable to correctly describe the expected observation as being *' no change in size of the potato strip*' for (c) (ii), and some mistakenly referred to the volume of the solutions instead of the size of the potato strip. Greater effort must be devoted to teaching this concept especially through the use of practical tools.

Module 2

Question 2

Syllabus Objectives: 3.1, 3.2, 3.3, 3.4
Highest Mark: 15 Mean mark: 4.85 Lowest mark: 0

Topics in genetics continue to be problematic for candidates. Part (a) of this question focused on knowledge of fundamental aspects of genetics, with candidates being asked to define two key terms, and to represent a dihybrid cross in the form of a genetic diagram. Part (b) tested candidates' understanding of the null hypothesis and the Chi-square test.

In Part (a) (i), many candidates were able to identify the interaction as *epistasis*. Incorrect responses included codominance, sex linkage, and independent assortment among others. In contrast, for Part (a) (ii), several candidates were unable to give simple or concise definitions of an allele as being *an alternative form of a gene* and that dominant refers to the *allele which influences the appearance of the phenotype in the presence of a recessive allele*. Responses to (a) (iii) clearly showed that candidates did not know what constituted a genetic diagram. Some consideration was given to the use of a Punnett square as part of the diagram. However, use of a punnet square alone was considered unacceptable. Other errors included genotypes not being clearly identified, incorrect representation of gametes, despite the fact that symbols were given in the question, and failure to show steps in sequence.

For Part (b) (i), most candidates gave the correct response of *9:3:3:1*, an indication that some aspects of dihybrid inheritance are fairly well understood. A few candidates a
ttempted to derive the ratios by calculating from figures given and incorrectly gave 7:3:3:1 as the answer. Only a small percentage of candidates were able to correctly state a null hypothesis for a Chi-square test for Part (b) (ii). Those who stated the hypothesis as being *one of no difference between observed and expected results* neglected to qualify the difference as being '*significant*', a term that is regarded as critical to the statement.

In Part (b) (iii), while the majority of candidates understood the concept of degrees of freedom and were able to correctly state the formula and do the simple calculation, a few mistakenly gave the Chi-square formula while others neglected to explain what 'n' represents.

For Part (b) (iv), most candidates were able to use the table provided to determine the given probability as being between 1 and 2 per cent. However, interpretation of the result, as required in Part (b) (v), proved to be more difficult as only the very competent candidates were able to give a correct conclusion for results obtained, for example *that chance alone could account for the deviation.*

Module 3

Question 3

Syllabus Objectives: 3.1, 3.8, 3.4
Highest Mark: 15 Mean mark: 4.44 Lowest mark: 0

This question tested candidates' knowledge of certain selected topics on human reproduction and their ability to do a plan drawing.

Overall, performance on this question was below the expected standard. For Part (a) (i), candidates were asked to identify three structural regions from a schematic diagram of the human male reproductive system. Interpretation of this schematic diagram seemed to present some difficulty, possibly because students are not routinely exposed to such diagrams. Teachers should ensure that students understand what is meant by a schematic diagram and how it should be interpreted.

Overall, only the structure representing the testes was correctly identified by the majority of candidates. Incorrect answers included the scrotal sac or testicles. Structure B was incorrectly identified by many candidates as being *vas deferens* instead of the *epididymis*. With respect to structure C, many candidates interchanged the terms uterus, ureter and urethra. Of particular concern is the degree of errors in the spelling of the correct answer, *urethra*, and technical terms in general. Teachers should advise students of the importance of spelling technical terms correctly. Stating functions of structures, as required for Part (a) (ii), was fairly well done although there were many instances where the specific functions of Structures X and Y were interchanged or where many candidates were unable to relate the particular structure to its specific function.

An inability to interpret a scale, measure the length of an item (using the given scale) from a given figure and clearly state values were evident in responses for Part (b) (i). Many candidates simply used the given measurement for the width of the head (2.5µm) and calculated how many times this value fitted into the entire length of the drawing of the mature human spermatozoon shown in the diagram. Conversion of the units was also problematic for many candidates. Of those who were successful in calculating the length of the spermatozoon, some converted the calculations into centimetres and metres. Again, this is indicative of weak practical skills with respect to drawings.

For Part (b) (ii), candidates failed to give an adequate comparison between the spermatazoon and the ovum based on features observed in the diagram. Again, it must be emphasized that when differences

are required, reference must be made to both items under comparison. For example, many candidates referred to characteristics of the spermatozoon but failed to state the comparative characteristics of the ovum or simply mentioned features of the ovum without reference to what was noted in the diagram given. Popular responses included 'the sperm is divided into distinct regions', 'the sperm is smaller' or 'the sperm has a tail' with no specific mention of the comparative difference in the ovum. Also, some candidates gave functional differences, not seen in the diagram, and hence, ignored the stipulation of the question 'with reference to the figure' which implied observable features.

Part (c) (i) was not well done as drawing skills continued to be below the expected standard. Despite the fact that a colour photomicrograph was used to ensure clarity, the majority of candidates were unable to follow the instructions given to do a plan diagram of the highlighted region; inability to apply knowledge and skills was very evident. Several candidates simply reproduced the entire figure of the mature Graafian follicle in a plan diagram, or those who attempted the plan diagram gave unwanted details; also, the labelling of the specific tissue layers was incorrectly done. These errors, routinely noted in the drawings for the School-Based Assessment, indicate that students continue to be unclear as to what constitutes a *plan diagram* versus a *detailed drawing*. Teachers are advised to pay close attention to the comments on the feedback forms concerning drawing skills for the School-Based Assessment.

Section B – Essay Items

Module 1

Question 4

Syllabus Objectives: 1.8, 4.2, 4.4
Highest Mark: 14 Mean mark: 4.33 Lowest mark: 0

This essay question examined candidates' knowledge of the levels of structural organization of proteins and tested their ability to apply this knowledge to describe the structure of collagen. Understanding enzyme activity and how enzyme activity is affected by insecticides were also tested.

Candidates experienced difficulty in correctly answering Part (a) (i). While most candidates knew the general levels of structural organization of a protein, they were unable to apply this knowledge to describe collagen. Some either stated the levels of organization of proteins in general or described the structure of collagen without reference to the levels of organization. In addition, there were many incorrect statements about either the levels of structural organization of proteins or about the collagen structure, both hinting at some degree of misconception. Errors included polysaccharides for polypeptides, the structure of cellulose for collagen, α and β glucose for α helix and β pleated sheet and DNA structure with protein structure. However, a few candidates understood what was expected and gained full marks. Candidates were expected to state that, for example, *the primary structure of collagen is the linear sequence of about 1000 amino acids which are joined by peptide bonds.* A good response for the secondary and quaternary structure of the protein was *in the secondary structure of collagen, each polypeptide chain is a loosely coiled helix (but not an alpha helix) with –CO and –NH groups projecting outwards and held by hydrogen bonds. In the quaternary structure of the protein, tropocollage, helices lie parallel to each other and form a stable covalent bond with neighbouring helices forming microfibrils.* The tertiary structure of collagen was the least understood.

It was expected that candidates should have been able to give the correct response of *fibrous protein* with a supporting description for collagen.

In Part (a) (ii), many candidates accurately identified a functional property of collagen but were unable to give an explanation for the property. Several described collagen as being 'elastic' or 'stretchy'. Candidates need to distinguish between 'flexibility' and 'elasticity'. Others stated that collagen was 'strong' and 'hard' instead of *possessing high tensile strength or resistance to stretching because of the overlapping of the staggered ends of the collagen fibrils.* Candidates were also expected to identify that collagen was *rigid because of the hydrogen bonding within the chains and within the triple helices* as another functional property.

Part (b) (i) was well done. Most candidates were able to gain at least one of the two allocated marks. There was some confusion between 'mode of enzyme' action and factors affecting enzyme activity. Candidates were able to recognize that the substrate interacted with the active site of the enzyme to form an E-S complex which then formed products. However, some candidates thought that the active site was located on the substrate.

Part (b) (ii) focused on the effect of insecticides on enzyme activity using a specific example. Candidates were expected to give an example of an insecticide, for instance, an organophosphate or a carbamate (it should be noted that pyrethroids are not the best example for this question). However, many candidates gave names of herbicides or general names of insecticides like Baygon. A number of candidates did not understand the term 'insecticide' and mistakenly wrote about the plant being sprayed with insecticide and then humans consuming this plant and the consequent effect on the digestive system. Candidates were expected to know that insecticides inhibit enzyme activity. They were also expected to discuss how the insecticides acted as competitive inhibitors or non-competitive inhibitors with the end result being that catalytic activity of the enzyme would be prevented and the enzyme activity would be decreased.

Module 2

Question 5

Syllabus Objectives: 2.1, 2.6, 5.6, 5.7, 5.8
Highest Mark: 15 Mean mark: 5.68 Lowest mark: 0

Knowledge of meiosis and understanding of the types of natural selection were examined in this question.

For Part (a) (i), candidates were asked to outline the stage of meiosis I and to comment on the importance of this phase of meiosis. The majority of candidates failed to answer the question as required. Many did not give the correct sequence of events for meiosis I and/or used incorrect terminology, for example, 'chromatids' instead of *chromosomes*. Stronger candidates were able to provide what was required, even giving details of chiamata formation and crossing-over. Of particular concern was the observation that some candidates opted to answer this part of the question using diagrams with little or no explanatory text or notations. While, for an essay, diagrams may be used to support descriptions, it is unacceptable to use only diagrams unless specifically stipulated in the question rubrics. Excellent responses made mention of the chromosome number being reduced from diploid to haploid and crossing-over resulting in genetic variation of the offspring. Part (a) (ii)

of the question was generally well done by the candidates who gave good responses such as the *daughter cells are genetically identical in the case of mitosis versus different for meiosis, or that daughter cells are diploid in mitosis and haploid in meiosis*. Weaker responses exhibited a lack of clarity and therefore failed to gain a mark in this area.

Part (b) of the question was designed to test candidates' ability to identify the type of selection based on information given, that is, *disruptive selection*. The majority of candidates were able to give the correct response and an appropriate justification, for example, reference to *only the two size categories present with no intermediates forms of bills.* Weaker responses stated allopatric speciation, Darwin's theory of evolution or co-dominance, hence suggesting a lack of in-depth understanding of the topic. Teachers must ensure that this topic is adequately covered in classes.

Module 3

Question 6

Syllabus Objectives: 1.1, 1.3, 2.4, 2.5
Highest Mark: 15 Mean mark: 5.47 Lowest mark: 0

The aim of this question was to examine candidates' knowledge of vegetative propagation and their understanding of the advantages and disadvantages of tissue culture as a tool for plant production. Knowledge of the strategies for promoting self-fertilization was also tested in Part (b).

Overall, performance on this question was not as good as expected. Part (a) (i) was generally well done. The weaker candidates failed to give a precise definition such as the *ability of plants to produce new plants from existing vegetative structures by asexual means*. In some responses instead of giving a definition, several examples of vegetative reproduction, such as cuttings and buddings, were stated. Some candidates did not mention that the process occurs in plants.

Part (a) (ii) posed a great deal of difficulty as candidates failed to discuss the advantages and disadvantages of tissue culture and simply stated relevant points. This resulted in either incomplete or superficial responses where candidates failed to discuss implications. Teachers must provide guidance as to what is expected when a question requires a discussion of information. A common misconception was that candidates referred to genetic engineering as an example of tissue culture.

Part (b) (i) required a simple distinction between pollination and fertilization. Less than 50 per cent of the candidates were able to gain full marks for stating that the *pollen grain was transferred from the anther to the stigma* and many more did not mention that *a zygote was produced after fusion of male and female gametes*. A common misconception was that fertilization only occurred in humans/animals and many replaced the term zygote with embryo. About 50 per cent of the candidates who attempted Part (b) (ii) scored full marks. Weaker responses described how a flower is adapted for insect and wind pollination instead of describing strategies to promote cross-fertilization. Candidates were expected to describe any two strategies such as *being dioecious, protandry/protogyny, self-incompatability and shape or arrangement of flowers*. In some responses, the strategies were simply stated with no attempt to describe them.

UNIT 1

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

Unit 1

Module 1

Question 1

Syllabus Objectives: 1.10
Highest Mark: 13 Mean mark: 8.96 Lowest mark: 4.0

This question examined candidates' ability to conduct an experiment based on given instructions.

Part (a) (i) assessed candidates' ability to conduct two food tests and record observations. A variety of colours were recorded as the end result for both the Biuret and the Benedict's tests. This suggests that the reagents available in many centres were either contaminated or past their expiration dates. It is recommended that centres selected for the conduct of Paper 032 examinations should ensure that they have access to adequate fresh supplies of reagents prior to an examination. A few candidates were able to score full marks for this part of the question.

For Part (a) (ii), there was some minor confusion in identifying the correct test being done in Procedure 1. Candidates commonly named the test for protein as the reducing or non-reducing sugar test. It is suggested that candidates pay more attention to learning the correct names for each food test.

In Part (a) (iii), most candidates accurately deduced that the first two tubes contained the nutrient but many could not identify the nutrient as protein, as well as the fact that tubes presenting no colour change/blue colour had no proteins.

As was the case in Part a (i), for Part (b) (i), candidates obtained a vast range of colours for the Benedict's test. Every colour in the spectrum was offered as an observation including purple and pink. The concept of the reducing and non-reducing sugar tests is one that needs to be more thoroughly reviewed as there were many incorrect responses for Part (b) (ii). Most candidates were able to deduce that D contained distilled water but did not pay attention to the fact that the question asked specifically about the test tubes used in Procedure 2. The correct answer, D2, was not offered in most cases.

In the majority of responses for Part (c) (i), candidates did state two of the three expected tasks needed before testing whole beans for a nutrient. Crushing and dissolving in water were commonly cited but very few mentioned filtering to get an extract. Stating a source of error was not well done but a few candidates managed to give a correct response.

Module 2

Question 2

Syllabus Objectives: 2.1, 2.2, 2.3
Highest Mark: 12 Mean mark: 6.0 Lowest mark: 0

Observing a specimen using a microscope, making representative drawings and solving a genetic problem on dihybrid inheritance were the skills examined in this question.

Overall, Part (a) was very badly done. For Part (a) (i), very few candidates produced drawings of the stages of mitosis, in onion root tip, that were consistent with what should have been observed from a root tip slide. Most representations were evidently textbook interpretations of what candidates should have observed. Few were able to correctly identify the stages drawn but many were able to correctly sequence the named stages for Part (a) (ii), again suggestive of memory/recall rather than analysis of given material. The correct response for Part (a) (iii) is *cell plate* but all responses indicated cell wall.

Those candidates who attempted Part (b) gave adequate responses with many correctly stating *RRSS* as the genotype for the homozygous purple-coloured flower for (b) (i). Not many candidates attempted to complete the Punett square but those who did were able to gain full marks. Very few attempted Parts (b) (iii) and (iv) and of those who did, even less were able to correctly deduce that phenotype of crossing a heterozygote with a homozygote was a purple flower and to suggest how the cross would have been different if both parents were heterozygous.

The overall impression, based on the responses to Question 2, is that the candidates were under-prepared for microscopy and genetics. Greater efforts should be made to adequately prepare candidates for this practical examination.

Module 3

Question 3

Syllabus Objectives: 4.5
Highest Mark: 16 Mean mark: 12.26 Lowest mark: 6.0

Data management and analysis were the skills being tested in this question.

In Part (a) (i), the bar charts were very well done with one exception. Many of the responses failed to give a suitable title. More stringent adherence to guidelines for doing graphical representations may prove beneficial. Identifying and describing trends from a graph continues to be a challenge for candidates. However, most candidates were able to identify at least two of the three expected trends. Transcribing data from a graph into a table format and interpreting data, as expected for Parts (b) (i), (ii) and (iii), were both well done. However, most candidates scored zero for Part (b) (iv), signalling that development of critical thinking skills is needed.

UNIT 2

Paper 02 – Structured/Essay Items

Section A – Structured Items

Module 1

Question 1

Syllabus Objectives: 1.1, 2.4, 2.9, 3.4
Highest Mark: 15 Mean mark: 8.25 Lowest mark: 0

This question tested candidates' knowledge of the structure of the dicot leaf and the practical skill of doing a detailed drawing. Knowledge and understanding of biological pyramids were tested in the second part of the question.

The question was generally well done. For Part (a) (i), the majority of responses correctly identified the labelled structures as *epidermal cells, palisade cells, veins/vascular bundle* and the *stoma/guard cell*. Common errors were epithelial cells for A and stroma for D. Many candidates gained at least three marks for the detailed drawing of the highlighted section of the photomicrograph in Part (a) (ii). Several candidates were unable to produce drawings with accurate magnifications and proportions, and omitted key cellular details. Most candidates were unable to calculate the actual width of the specimen and some did not state the appropriate unit of measurement.

For Part (b) (i), many candidates were unable to score the full two marks for the definition because they failed to give a comprehensive definition of the term 'biological pyramid', for example, *a diagrammatic representation of the feeding relationships between organisms in an ecosystem*. A misconception was the use of the term 'food chain' instead of 'ecosystem' in the definition. Not many candidates were able to identify the pyramid as a pyramid of energy or to explain the significance of a pyramid of energy. Many replicated the details shown on the pyramid instead of highlighting *energy loss as it is transferred from one trophic level to the next.*

Module 2

Question 2

Syllabus Objectives: 1.6, 5.2, 5.5
Highest Mark: 15 Mean mark: 8.61 Lowest mark: 0

This question tested candidates' knowledge of the apparatus used to investigate the effect of environmental factors on the rate of transpiration. The second part of the question focused on the mammalian nephron and examined candidates' understanding of water conservation and the role of the loop of Henlé.

For Part (a) (i), most candidates seemed to know that the syringe was used to reset the reading or to replace the water removed. However, there appeared to be some misconception concerning the role of the syringe as several responses indicated that the syringe was used to remove the bubbles from the apparatus or to move the bubbles along the capillary tube. For Part (a) (ii), some students had

difficulty stating two precautions. Teachers should highlight this aspect when discussing experiments. Popular answers included *cutting the shoot under water* or *setting up the apparatus under water* among others.

Part (a) (iii) was not done very well as several responses failed to state both distance and time, giving instead an incomplete answer. A few candidates gave volume and diameter of the bore of the capillary tube as their response. It should be noted that volume is not a visible measurement in the capillary tube but must be calculated. Part (a) (iv) was well done with the majority of candidates gaining the full marks for stating that the experiment must be repeated to ensure reliability.

Part (a) (v) proved challenging for most candidates with a few candidates attaining the full two marks awarded for this section. Candidates were expected to state that the plant would be exposed to the sunlight and the control of the investigation would be under dark conditions. Also, candidates had difficulty in understanding the term 'control', a feature noted in the reports of the School-Based Assessments.

Less than half of the candidates were able to gain the full marks for Part (b) (i). Some candidates lacked a sound understanding of functions of the regions of the Loop of Henlé. Most of the candidates scored the one mark for Part (b) (ii) for stating *that energy was required for active transport*. A few candidates simply stated that the numerous mitochondria were required for active transport which was already given in the rubric. For Part (b) (iii), approximately half of the candidates attained full marks for giving a clear statement that the urine would be more concentrated in small desert mammals and that the loop of Henlé would be longer. Some gave juxtamedullary nephron as a response and neglected to focus on the Loop of Henlé as required. Part (b) (iv) was generally well done as candidates were able to identify the two regions as being Bowman's capsule/glomerulus/ basement membrane/renal corpuscle and the proximal convoluted tubule.

Module 3

Question 3

Syllabus Objectives: 1.3, 1.4, 3.5, 3.6
Highest Mark: 15 Mean mark: 9.14 Lowest mark: 0

This question was designed to test candidates' understanding of incidence rate and ability to analyse data and reproduce a bar graph of given data. The second part of the question focused on knowledge of the HIV life cycle and routes of transmission.

Overall, this question was well done with many candidates giving satisfactory answers. In some instances, almost full scores were awarded. It is clear that candidates had a good understanding of the relevant topics.

Part (a) (i), worth two marks, posed some difficulty as candidates failed to explain that incidence rate was *the number of new cases of diseases occurring during a given period in a given population*. Most candidates scored one mark for recognizing that it was the occurrence of a disease during a given time in a given population but neglected to mention new cases. Part (a) (ii) was designed to test candidates' ability to draw a bar graph to represent the data for two countries. Common errors

included drawing of a histogram instead of a bar graph, the drawing of two separate bar graphs and the omission of a key. Most candidates were able to plot the points accurately and use bars of the same width. The axes were, for the most part, accurately labelled and candidates easily scored three marks or more out of the five. Very few candidates scored full marks in Part (a) (iii) because of inadequate comparisons of the trends shown. Candidates easily determined that the rates were higher for one country compared to the other but only some of them were able to score the second mark for observing that the rates of one country fluctuated more than the other.

About 30 per cent of the candidates answering Part (b) (i) were able to concisely describe the stages highlighted in the diagram of the replication cycle of the Human Immunodeficiency Virus. Candidates who attained high scores accurately stated that

- *the virus injected its RNA into the host cell*
- *reverse transcriptase was used to make viral DNA from viral RNA*
- *viral DNA was incorporated into the host DNA*
- *virus breaks free from host cell*

Common misconceptions were that the entire virus entered the host cell, virus RNA entered the host nucleus and that the virus cloned itself as it left the host cell.

The two distinct routes required in Part (b) (ii), by which HIV can be transmitted to humans, were almost always given. Candidates performed well as over 95 per cent accurately stated any two of the following: *blood transfusion, across placenta, during breast feeding or sharing needles.*

Section B – Essay Items

Module 1

Question 4

Syllabus Objectives: 1.3, 2.7
Highest Mark: 15 Mean mark: 7.02 Lowest mark: 0

The main topics examined in this question were phosphorylation and the nitrogen cycle.

Generally, Part (a) was well answered by the majority of candidates who gave expected responses indicating a sound knowledge of phosphorylation. Some candidates simply responded by stating that 'phosphorylation involved the addition of a phosphate molecule' without identifying the recipient of the molecule. Other candidates stated either a 'substance', or a 'compound', and a few gave the initial steps of glycolysis as the only means of describing the process.

In distinguishing between photophosphorylation and oxidative phosphorylation, many candidates stated that photophosphorylation involved the use of light from the sun to manufacture ATP but many were unable to accurately distinguish this description from oxidative phosphorylation by outlining, for example, that the latter is the *process in which most ATP molecules are made by ATP synthase enzymes in the respiratory chain and that the process requires oxygen.* A clear understanding of the concept, that, in photophosphorylation the source of high energy electrons is water compared to organic molecules, as occurs in oxidative phosphorylation, was not evident in responses.

Part (b) of the question was generally well done with the majority of candidates giving an acceptable discussion of similarities and differences between the two processes mentioned before.

Part (c) (i) was the most comprehensively done section of the question. Many candidates were able to gain most of the marks by detailing the particular steps involved in the three processes, *nitrification, denitrification* and *nitrogen fixation* as expected. Using nitrogen fixation as an example, a typical response was 'this involves the fixing of atmospheric nitrogen to be used by plants' with no mention of steps, the organisms or environmental factors involved; similar responses were given for the other two aforementioned processes.

Part (c) (ii) was reasonably done, many candidates achieved more than half of the allocated marks. Despite this, many candidates did not link the statement outlining the problem to the nitrogen cycle, to which the question related.

Module 2

Question 5

Syllabus Objectives: 2.5, 3.10, 3.11, 3.12
Highest Mark: 15 Mean mark: 4.96 Lowest mark: 0

This question examined candidates' understanding of haemoglobin as an efficient carrier of oxygen and knowledge of the oxygen dissociation curve. The second part of the question dealt with translocation and understanding of the mass flow principle.

For Part (a) (i), many candidates were able to gain at least two of the allocated four marks awarded for explaining why haemoglobin is an efficient carrier of oxygen. Candidates were expected to state that the *haem group binds to the oxygen molecule and up to four molecules of oxygen can be transported*. Candidates with a clear understanding of the process mentioned *co-operative binding of oxygen molecules* to the haem group. Additionally, many candidates were able to state that *haemoglobin binds reversibly to oxygen.* Several candidates incorrectly wrote about the adaptations of the red blood cell for transporting oxygen instead of haemoglobin. Part (a) (ii) was the most challenging part of the question for many candidates who explained rather than described the shape of the graph. When describing a graph, reference to information from the x-axis should be related to information from the y-axis. One obvious feature is the fact that *the curve is 'S' shaped (sigmoid).* Other features include the fact that *the initial part of the curve is steep*, that *the curve plateau (flattens)* or that *beyond a certain point, increasing the partial pressure of oxygen does not alter the shape of the curve.* Common misconceptions were: (1) that the sigmoid curve is drawn as the letter 'S' and (2) a discussion on the Bohr effect was required rather than a description of the oxygen dissociation curve.

Part (b) (i) was generally well done by candidates. Teachers should ensure that required definitions are thoroughly covered. In Part (b) (ii), many candidates were able to gain the one mark awarded for this part of the question, outlining the mass flow principle, by stating that mass flow is the *bulk transport of materials from one point to another as a result of pressure differences between the two points.* In teaching this topic, the distinction between a process (translocation) and mechanism of the process (mass flow) must be highlighted. Correct experimental evidence included the *use of aphids and the ringing of the bark of trees*. These two pieces of experimental evidence were most frequently

quoted. Other acceptable answers included a *description of the movement of viruses when exposed to light in the phloem and the observation of mass flow in microscopic sections of living sieve tube elements.* In discussing the evidence, candidates were expected to mention that a pressure difference was observed, hence the link to mass flow principle.

Module 3

Question 6

Syllabus Objectives: 2.4, 2.5, 4.2, 4.3
Highest Mark: 15 Mean mark: 5.70 Lowest mark: 0

Knowledge of the differences between cell-mediated and immune responses, and understanding of physical and psychological drug dependency were examined in this question.

The section dealing with the immune responses was poorly done by the majority of candidates who experienced difficulty in giving clear distinctions for cell-mediated and humoral. For Part (a) (ii), while many candidates seemed to understand what was required, several had difficulties in using their knowledge to explain the immunological process and simply stated information. A good understanding of primary and secondary responses was evident but explanations were vague or not logically presented.

Distinguishing between physical and psychological dependence on drugs was reasonably done by candidates. Once again, knowledge was evident but points were not well written. In attempting to explain the possible effects of long-term consumption of alcohol, candidates did not clearly distinguish between physical manifestations and possible outcomes, for example, *brain damage leading to loss of short-term memory*. Some candidates failed to note that the question focused on the nervous system and therefore answers dealing with the liver were unacceptable.

UNIT 2

Paper 032 – Alternative to the SBA

Question 1

Syllabus Objectives: 2.8
Highest Mark: 13 Mean mark: 8.73 Lowest mark: 5.0

In this question, candidates were required to design an experiment to determine the rate of respiration in seedlings.

For Part (a) (i), candidates displayed a good working knowledge of the procedure and the majority of them managed to list at least six steps. However, there were common errors as follows:

- Many candidates could not identify a suitable control in the method described.

- Many candidates could give only vague details on how to measure the rate of oxygen uptake.

- Most methods described did not include 'enough time for equilibrating'.

In Part (a) (ii), limitations of the procedure were also not well described, a shortcoming often encountered in practical exercises. Candidates seemed unable to distinguish between a precaution, a source of error or a limitation. For Part (a) (iii), about half of the candidates correctly stated the purpose of the soda lime granules (to absorb carbon dioxide) and the glass beads (to control) used in the investigation.

In Part (b) (i), though candidates elected to show working, many did not generate the correct answer. In teaching experimental procedures, greater attention needs to be given to the calculation of rates. The difference between the rate of oxygen consumption at 25°C and 35 °C was clearly identified but the explanations for the faster rate at the higher temperature was not obvious to many of the candidates.

Question 2

Syllabus Objectives: 3.1, 3.2, 3.9
Highest Mark: 11 Mean mark: 5.09 Lowest mark: 1.0

This question was designed to test drawing skills using a mammalian blood smear and section of a blood vessel. Overall performance for this question was poor as microscopy and ability to produce a reasonable quality drawing continue to be weak areas for candidates.

Part (a) (i) was the weakest section in the question. Candidates were rarely able to correctly identify the white blood cells on the slide. The drawings suggest that candidates, at some centres, observed what was intended but failed to correctly identify the cells. Despite the poor performance, it should be noted that the clarity of the drawings was generally good. The calculations of the magnification were incorrect and it would seem that candidates were unable to convert µm to mm/cm.

The plan drawing done for Part (b) (i) had several common errors as follows:

- Most candidates labelled the layers incorrectly.

- In most cases the tunica intima was not shown as being wrinkled.

- Most candidates had too many layers or included details for the required plan drawing.

However, even though not appended to the labels, the quality of the annotating notes was good.

Question 3

Syllabus Objectives: 4.5
Compulsory question: Maximum Marks = 16
Highest Mark: 16 Mean mark: 10.82 Lowest mark: 9.0

Data management and analytical skills were examined in this question.

In Part (a) (i), the graph was well done but with one common flaw — few candidates recognized the need to show the y-intercept of the graph, perhaps because no zero value was provided in the data table. For Part (a) (ii), most candidates could clearly identify at least one limitation that would affect the interpretation of the collected data on smoking and the incidence of cancer.

For Part (b) (i), the description of the findings of the survey was also fairly done with most candidates correctly identifying the trend. Part (b) (ii) was badly handled. Most candidates recognized the correlation between smoking and cancer but few of them were able to account for the correlation. Where candidates managed to identify the carcinogen in the cigarette, they failed to show how it led to cancer. There was very little mention of tobacco's carcinogens switching on oncogenes or altering genes so that uncontrolled mitosis occurs. In Part (b) (iv), most candidates correctly concluded that *smoking promotes cancer*.

General and Specific Recommendations for Teachers

The importance of focusing on concepts and ensuring that these are adequately taught is once again 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 or synthesis of information. Also, greater attention must be placed on ensuring that students are able to correctly spell technical terms and understand the rubrics of a question, in particular, 'discuss' and 'distinguish'. Finally, the importance of mastering practical skills must be conveyed to students as these skills will be examined in the final examination papers.

General Issues Concerning Paper 032

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

General Comments on the SBA

Overall, a marginal improvement was observed with respect to the quality of the SBAs and the skills assessed. For Unit 1, Drawing Skills (DR) continue to be below the expected standard and, therefore, the weakest of the skills assessed for this unit. This weakness is clearly reflected in the poor performance of candidates on questions testing drawing skills (for example, Question 3 in Unit 1). In Unit 2, the skills, Planning and Design (PD) and Analysis and Interpretation (AI) still pose a

challenge for several teachers and students. Teachers are reminded that each laboratory activity/experiment should only be assessed for two skills at any given time. A minimum of a pair of practical exercises must be used to provide the average score for each skill. Despite this, teachers still have to reinforce the standards expected by practising and presenting additional experiments apart from those being moderated in the skill area (AI, DR, P&D, ORR and MM). Finally, it should be noted that these skills are assessed in Section A questions for both units.

Scores which are recorded on the moderation sheet need to be expressed as an average and also as a whole number and not as a fraction. Finally, the mark awarded for the assignment must be clearly shown and presented out of a score of 12. Teachers are reminded that the gained score along with constructive feedback must accompany each assignment/laboratory activity marked. Feedback affords students the opportunity to improve future assignments.

Planning and Design (PD)

- Hypotheses need to be logical and testable and ideally test for ONE variable.
- 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.

Wholesale replication of textbook laboratory exercises was still seen, and, far too often. This practice continues to limit students in attaining high scores for this skill. Teachers must guide their students in the formulation of authentic Planning and Design exercises. Other areas of concern include the poor formulation of hypotheses and related aims. Also, the reliability of any experiment hinges on the repetition of findings. The use of a control experiment is also essential in such experiments and need not be confused with a control variable. In several cases, too many variables were being tested at once, thus creating difficulty in producing an applicable 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 PD assessment, need to follow the CAPE PD mark scheme.

Analysis and Interpretation (AI)

One of the AI criteria requires that background information accompany the analysis of results. Data collected must be used to highlight trends/comparisons. Linking these trends with/to supporting literature/background information as a basis for reinforcing findings is important and critical. The use of drawings and electron micrographs for assessment of AI skill is inappropriate. Formulation of 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 conceived.

These areas for immediate improvement were highlighted by moderators:

- Adequate inclusion of background information
- Deducing trends and relationships from data collected
- Presenting concise explanations of the observed trends and relationships
- Understanding the relationship between data obtained and the original aim/hypothesis of the experiment

Limitations are uncontrolled occurrences that have to be worked around and their impact must be considered when analysing the raw data. A source of error may also be a limitation. However, a precaution is what is done, to the apparatus or materials, as a preventative measure. It ensures that execution of the method occurs flawlessly.

It is suggested that territorial workshops and internal standardization of teachers responsible for SBA's at a given centre, be implemented. This will provide candidates with all the necessary tools to produce work of the highest quality. Perhaps this could be done using the technology and by distance learning.

Drawings

There is still great concern in this area of assessment. Some teachers have allowed students to submit textbook drawings as their own. It is important that students provide true representations of specimens/slides provided and examined. Reproductions of drawings in textbooks are not appropriate for assessment of drawing skills.

An assessment of drawings is based on the following criteria:

- 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
- Having correct proportions of all components of the specimen is essential.
- Title must be placed at the bottom 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 etc.
- 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.

Adherence to these guidelines will afford candidates the opportunity to attain high or even full scores for this skill.