CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2008

BIOLOGY
(REGION EXCLUDING TRINIDAD AND TOBAGO)

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CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2008

GENERAL COMMENTS

This year, the examination has a new format following a review of the syllabus. The examination now comprises Paper 01, a Multiple Choice paper consisting of 45 items, 15 from each of the three modules; and Paper 02, consisting of six questions. Paper 02 is divided into two sections – Section A and Section B. There are three compulsory structured questions in Section A, one testing each module and three essay questions in Section B, one testing each module. Each question on Paper 02 is worth 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

- Bioenergetics
- Biosystems Maintenance
- Applications of Biology

This year, 1 725 candidates registered for the Unit I examination. The overall mean was 58.3 per cent and 93 per cent of the candidates achieved Grades I – V. There were 1 242 candidates registered for Unit II. The overall mean was 58.2 per cent and 95.3 per cent of the candidates achieved Grades I - V.

DETAILED COMMENTS

UNIT 1

PAPER 02

SECTION A

Module 1

Question 1

In Part (a), candidates were tested on a drawing of a dicotyledonous root, and required to identify the eight structures labelled. This was an easy introductory question, testing a practical skill, but candidates did not perform as well as expected.

In Part (b), many candidates did not distinguish between drawings of cells and plan diagrams of tissues. They were required to draw an outline of the areas of the tissues without giving details of the individual cell structure. Credit was given for (i) giving a plan diagram of the distribution of tissues, (ii) placing the diagram in the correct location in the rectangle, and in the correct proportions and (iii) giving the correct location and proportions of the xylem and phloem in the stele. Strong candidates read the question carefully and displayed the required skills, while others drew cell details, text book drawings or stem-like memorized sketches.

Part (c) tested calculation skills on magnification and candidates were asked for the actual width of the specimen from X1 - X2, given that the photograph had been magnified 100 times. Candidates should have measured X1 - X2, (11 cm or 111 mm), and divided it by the magnification (100), resulting in an actual size of 1.1 mm. Acceptable ranges in micrometres, millimetres or centimetres were credited.

In Part (d) (i), the electron microscope has a higher resolution than the light microscope and can distinguish between two points at higher magnification, producing a sharp image. With the light microscope the resolution does not increase as the magnification increases, so the image becomes bigger but blurred. Fifty per cent of candidates were unable to explain 'resolution' or 'resolving power' and it was often confused with magnification. The reason for a better resolution lies in the wavelength of light rays and electron wavelengths so that the separation capacity of the electron wavelengths between cell structures is much finer, narrower and more acute.

Part (d) (ii) which dealt with the advantages and limitations of the light microscope compared with an electron microscope, was well answered. Examples given with respect to the light microscope were: the specimens were quicker and easier to prepare; living cells and small animals can be observed without damage; stained specimens provide for colourful distinctions between tissues, and users need minimum skills. The limitations included the light microscope's resolution and its power of magnification. At least one advantage and one limitation were required, and the three points should have been clearly explained. A variety of minor issues was given for the advantages, and some were accepted, but technical and operational differences were expected, so that 'convenient carrying cases' and 'fitting on trolleys' showed failure to grasp the point.

Module 2

Question 2

In Parts (a) (i) and (ii), the genotype of the F1 plant is RrCc. The phenotype is pink because, as stated, R (red) and r (white) are co-dominant and the dominant allele for enzyme production 'C' is present, so that genotype colour can be expressed. Red, white and pink flower colour is a commonly used example to demonstrate co-dominance. In Part (c) (i) of the question, the fact that red, pink and white flower colour is a component of this question is made obvious. Approximately 25 per cent of the candidates were able to score full marks for correctly answering both the genotype and the colour.

In Parts (b) (i) to (iv), candidates were asked to consider the dihybrid genotype, RrCc in (a) (i) above and state the four allelic combinations in the gametes. They were RC, Rc, rC and rc. A satisfactory number of candidates gave the accurate answer, but many gave erroneous combinations such as RR CC rr or cc. This question was considered to be a very straightforward enquiry into the candidates' familiarity with basic genetics. It was assumed that all candidates would have been competent with this material.

In Part (c) (i), those candidates who were able to give the correct allelic combinations in the gametes in (b) above were able to score full marks in the Punnett square. In marking this part of the questions, a

maximum of two errors was allowed in completing the grid. However, there were several candidates who appeared not to understand the concept of the Punnett Square.

In Part (c) (ii), most of the candidates who got the correct genotypes, earlier, were able to determine the correct phenotypic ratios. Application of knowledge on co-dominance and epistasis was required and candidates needed to have read the introduction carefully. Whenever the alleles CC or Cc were present in the genotype, the enzymes were able to produce the pigment, be it RR (red), Rr (pink) or rr (no pigment, and therefore, white). Wherever the double recessive allelic combination for colour, 'cc' is present, the enzyme systems cannot be interpreted, a coloured pigment is not produced and the petals remain white.

In Part (d), the majority of candidates scored full or almost full marks. Occasional errors in calculation indicated that candidates either did not have the use of a calculator or were unaware that the square of a negative number gives a positive answer.

In Part (e) (i), almost all candidates scored the mark for stating that the degrees of freedom is 'the number of classes minus one'. However, in Part (e) (ii), it appeared that some candidates did not know how to interpret the Chi-Squared table. The 5 per cent probability should be read as 0.05 (bottom row of the table). They should follow that column vertically to its interception with the row labelled '1 Degree of Freedom'. The value is 3.84. The result obtained from the calculation, 0.25, is less than 3.84 and is therefore insignificant. Some candidates stated that 0.25 is less than 0.5 and erroneously gave this as the reason for insignificance.

In Part (e) (iii) the majority of candidates were able to explain that a large Chi-squared value of 7 would have been significant because it is greater that 3.84 and decreases the probability below 0.05, (5 per cent) to less than 1 per cent. The result would have been due to some other factors or bias and not to chance alone.

Module 3

Question 3

In Part (a) (i) candidates were asked to study Fig 3, showing the structure of the mammalian ovum and sperm, and to state four structural differences between them. Well-constructed sentence was required for each difference and not just a few words. The obvious answers included size, where candidates should have referred to the actual sizes given, or calculated the proportions, instead of just stating 'bigger' or 'smaller'. Such an answer fails to lift off information from the graphic and demonstrates limited initiative by the candidate. Other responses referred to the acrosome, the corona and zona, and the mitochondrion-filled middle piece and flagellate tail. The drawing of the sperm did not include the nucleolus nor cytoplasm.

In Part (a) (ii), concerning the ways in which the ovum and the sperm were suited to their respective functions, the streamlined shape of the sperm and the nutrient-filled cytoplasm of the ovum, the functions of the corona and zona in the egg and the acrosome and mitochondria in the sperm, were all cited. At least one point was required for each of the ovum and sperm. The majority of the candidates scored three of the four available marks.

In Part (b) the correct answer was that meiosis I has been completed with the production of the first polar body, and that meiosis II, which produces the second polar body and the actual ovum does not occur until after the sperm has entered the structure shown. Several candidates explained this meiotic sequence clearly and gained two marks. Credit was given for a reasonable effort, for example that the structure is

haploid; that it is presently unfertilized; that entry of the sperm leads to diploid zygote formation and sealing of the zona, and gained partial credit.

In Part (c) (i), when required to produce a graph, candidates must always provide the following: an appropriate title, the horizontal X axis with class intervals and identity, the vertical, variable Y axis, labelled similarly and the points plotted correctly. Four accessible marks were available for this routine question. Many candidates omitted the title and confused the X and Y axes and the labelling of axes was often incomplete. Since graphs are frequently tested in Paper 2, Section A, candidates need to prepare themselves well to enhance their scoring capacity.

In Part (c) (ii), the answer could be deduced from either the graph or Table 4. At the highest sperm velocity, 0.28 mm per sec, fewer sperm, 2.0 per cm^3 were needed to fertilize the ovum. Good candidates generally scored well on this section, while others found difficulty in observing the overall trend and instead stated that it fluctuated.

SECTION B

Module 1

Question 4

In Part (a), candidates needed to show the glucose and fructose molecules joined by a glycosidic bond. Very few candidates gained full marks, with the fructose molecule being the stumbling block.

In Part (b) (i), the answers to this section were vague. While the majority were able to identify water as being a polar molecule, there were inadequate references to the positively charged H+ ions and the negatively charged OH- ions. These charges interact with ionized solutes, salts and so on, and surround, separate and dissolve them.

In Part (b) (ii), the charges on the water molecule attract other water molecules and bond cohesively with them forming a surface layer under high tension which resists perforation or separation. The cohesion also permits capillarity in the narrow xylem tubes. Most candidates gained one mark for describing the surface film, but were unable to relate the charges to the cohesive property.

In Part (c) (i), the majority of the candidates gained full marks, indicating that this topic is well taught and understood. However, several candidates did not explain that the enzyme is the larger globular protein, (the lock), and the substrate is a smaller molecule, (the key). The small key should be visualized as entering the large (enzyme) lock at the keyhole, 'active site'.

Part (c) (ii), which tested competitive and non-competitive inhibition was also well done by the majority of the candidates. They gained marks for comparing their definition, sites of impact, differing effects on the active site, and the consequent effects on the operation of the enzyme, especially in relation to increasing substrate and the extent of reversibility.

Module 2

Question 5

The question tested the candidates' understanding of variation, directional and stabilising selection as well as genetic engineering.

In Part (a), two causes of variation in sexually produced organisms were required. Approximately 50 per cent of the candidates were able to identify as least one cause. Meiotic crossing over, random assortment of homologous chromosomes, gene or chromosome mutations and random fertilization were most common.

Part (a) (i) and (ii) which tested directional selection and stabilizing selection, required well-drawn graphs, good examples and clear explanations. However, graphs often lacked details or labels to point out the shift for directional selection, or the extremities which showed the phenotypes at a disadvantage, as seen in stabilising selection. Several directional examples: neck length in giraffes, industrial melanism in the Peppered Moth and antibiotic resistance in bacteria were acceptable. For stabilising selection, birth-weight in babies was useful. There were many unacceptable examples. Candidates should be familiar with the standard examples and not fabricate unlikely situations.

In Part (b), it must be emphasized that the details of the four key steps involved in producing a piece of recombinant gene are expected from all candidates at this level. The more able candidates gave details on the required steps, including the isolation, fragmentation, insertion and multiplication processes involved in producing the recombinant DNA section. Facts on the action of restriction enzymes that cut the DNA into fragments and the enzyme ligase which joins the ends of the two pieces of DNA were needed.

In Part (c), most candidates failed to discuss the major issues concerning the application of genetic engineering. Single words such as 'moral', 'social', 'ethical' and 'religious' were frequently listed with little or no explanation or development of the point. Issues relating to human and environmental safety, animal ethics, human cloning and cost of treatment issues were most commonly cited.

Module 3

Question 6

In Part (a), many candidates focused on the structural aspect of the female reproductive system rather than discussing the biological basis for the two methods of contraception: rhythm and contraceptive pill. They did not apply their knowledge to answer the specific question, but instead presented what they knew about the structure of the organs in the hope of gaining marks.

In Part (a) (i), for the rhythm method, candidates should have referred to the 28 day menstrual cycle and pointed out that ovulation occurs at mid-cycle, (approximately the 14th day). By monitoring the cycles over several months, the date of ovulation can be predicted. Since the ovum will be in the Fallopian tube at Day 14, intercourse at that time can be avoided. Such avoidance should occur three days before ovulation (to prevent active sperms being present in the oviduct prior to ovulation, or to counteract early ovulation), and three days after ovulation, since the ovum is viable for three days, and could be fertilized by sperm deposited on Day 17. Most candidates suggested avoidance between Days 12 to 16 of the cycle, but did not give adequate reasons. A number confused the rhythm method with withdrawal. However, the question was answered quite well by the majority of the candidates.

In Part (a) (ii) for the contraceptive pill, candidates were expected to state any of the following options: the contraceptive pill contains oestrogen and/or progesterone, that FSH action is modified, that Graafian follicle development is arrested, ovulation does not occur or that the ovule is not available for ovulation. A few candidates mentioned the progesterone pill ('pop'), and described its biological basis accurately. Almost all of the candidates stated that without the ovum, effective contraception due to non-fertilization, occurred.

In Part (b), most candidates responded well and met the expected requirements. The expected response was an explanation of the role of the placenta as a guardian for the developing foetus by describing it as firstly a physical barrier, preventing direct maternal/foetal blood exchange, and as a blood pressure reducer. As a chemical barrier, controlled trans-placental transport should have been mentioned, for example, restriction of larger protein molecules, hormones and most harmful pathogens. Selective absorption by active transport or facilitated diffusion by placental membranes also exert control against harmful substances passing to the foetus. The removal of waste and provision of oxygen and food also qualify its role as a guardian.

Several candidates referred to the amnion instead of the placenta. Where the term, 'protection of the foetus by the placenta' was given, it was accepted, provided such protection related to the physiological and chemical barrier functions against toxins and pressure and not physical protection, which is the role of the amniotic cavity and its fluid.

Part (d) tested the candidates' knowledge of how cross fertilization is promoted. Several candidates dwelt on cross and self pollination, which is mentioned in the explanatory notes to this objective. A small percentage of the candidates mentioned that genetic variation and an enriched gene pool result from cross fertilization, and that reduced variation or inbreeding result from self-fertilization. The retention of a valuable genotype through self-fertilization and the chance of receiving unfavourable alleles through cross fertilization was mentioned. The reliability of self pollination and the wastefulness of cross pollination were also good answers. However, this section did not produce good scores because most candidates failed to relate plant sexual reproduction to genetics and variation.

UNIT 2

PAPER 02

SECTION A

Module 1

Question 1

In Part (a) responses to this question did not reflect the expected standard. However, the majority of candidates were able to achieve more than half of the available marks. A small percentage of candidates scored full marks. Candidates should apply their knowledge of the principles of operation of a simple respirometer to the apparatus shown. Good responses should have clarified that the apparatus must be airtight, the initial and final levels must be noted, the use of the calibrated scale is essential, organisms should respire for a set period of time, Tube B is a control and that the filter paper soaked with potassium hydroxide absorbs carbon dioxide more efficiently.

Part (b) (i) was poorly answered. The expected response was to use glass beads, boiled peas or other non-living material as a control. Some candidates had difficulty differentiating a controlled variable from a control for the experiment.

In Part (b) (ii) about 60 per cent of the candidates were able to score at least 3 of the 4 marks. Most were able to get the X and Y axes correct, the independent and dependant variables respectively. Appropriate class intervals and a good, descriptive title were needed. Definite marks, small circles or x's should be used to plot the points.

Part (b) (iii) was quite well done but some candidates did not identify the units and lost a mark. The expected answer was at 10'C – 0.33cm3/min and at 25'C – 0.72cm3/min.

In Part (b) (iv) (a) for one mark the answer was 1- + 25'. The majority did well with the following response: the rate of oxygen uptake increases with an increase in temperature.

In Part (b) (iv) (b) for one mark the expected response was 'germinating seeds have a higher rate of respiration than non-germinating seeds'. The majority of candidates did well.

Module 2

Question 2

In Part (a) (i), almost all candidates were able to read the bar graph and record the figures in the table to attain the two marks. Consistency was necessary when selecting the length to measure, that is candidates should have measured from the base to the top of the column for each column. Although the cells of the table were filled in correctly, candidates had difficulty with the calculation of the percentages.

In Part (a) (ii), the candidates were asked to determine the difference between the diameter of the trunk of the tree and the shallow roots and to account for the difference. Few candidates gave a good response, that is, that the shallow roots were surrounded by soil water at a higher water potential, causing water influx, and that the large volume of water available to be conducted upwards was associated with the wide lumen of the vessels. Concerning the trunk xylem, candidates failed to explain that there was less water volume and a greater transpiration pull, causing a deficit or 'suction' on the water column resulting in narrower vessels being produced by the plant in order to overcome cavitation. Many of the answers indicated misconceptions concerning pressure relationships in these areas, with 'pressure' being applied to the trunk, instead of 'tension'.

In Part (a) (iii), two factors other than transpiration pull were required to account for water movement up the xylem. Popular answers were capillarity, cohesion-tension theory or root pressure. Some candidates erroneously quoted factors which affect the transpiration pull, such as humidity and light.

In Part (b) (i), candidates performed only moderately at identifying the three main types of tissues shown as xylem, cambium and phloem.

In Part (b) (ii), candidates were given instructions to draw the four cells with an 'X' in them, and all the cells between them at a magnification of x2. The answers showed that candidates require much more instruction in drawing plant cells. Many candidates drew the cells floating apart from each other, or in a line. Only a few candidates produced adequate drawings.

Part (c) (i), which required the identification of all three structures - the sieve plate, the companion cell and the sieve tube, (or vacuole, lumen, phloem tube) proved challenging for the majority of candidates.

In Part (c) (ii), a number of candidates gained two out of the three allotted marks for accurately relating each structure to its function. Responses included the existence of the plate, as a modified end wall is to support the living tube, the sieve plate facilitates transport of food, bypassing active transport, and reducing ATP expenditure and membrane pumps, permitting 'mass flow'. Candidates should be thoroughly familiar with the extensive functions of the companion cells, and use them to their advantage to gain maximum marks. These features should not just be listed, but their functions carefully described, as requested.

Module 3

Question 3

Part (a) was well done with most candidates earning at least two of the six marks for their graph. Almost all of the candidates had the points correctly plotted.

In Part (b), more than 90 per cent of the candidates performed satisfactorily, but many focused their attention on previous knowledge of obesity and fast food outlets instead of using the data that were presented to them in the Table and the completed graph. Some candidates indicated a percentage overall increase whereas they should have noted the increase over the time specified in the question. Other candidates did not refer to the data in thousands or millions as specified and many candidates did not give the year of the data they were referring to. Candidates need to know how to use facts, get the descriptors correct and produce sentences comparing two descriptors, two or three magnitudes and a sequence of times, to prove a point.

In Part (c), while many candidates performed below the required standard, there were some with perfect responses. Following the existing points of their plot, they were able to show that the increase in prevalence of obesity exceeds the comparative increase in fast food outlets. This indicates that fast food outlets are not the sole cause of obesity, since obesity is outpacing them. The better candidates furnished excellent responses.

In Part (d), the candidates were required to explain the factors which caused obesity, other than the availability of new fast food outlets. Some of the most popular answers were: lack of exercise, modern convenient transport, overeating and gluttony, stress and genetic predisposition. Lists were not accepted since discussion and explanations were required. There were some inaccuracies about diabetes causing obesity, but in general candidates wrote well.

SECTION B

Module 1

Question 4

In Part (a), candidates were expected to provide at least two structural points and explain how these structures enabled the thylakoids to carry out their function. Structural points included the thylakoids are fluid-filled, disc-like structures with a very large surface area offered by there being thousands of thylakoids (arranged in grana) in each chloroplast, and the fluid inside the discs is separated from the external stroma by the membranes; the membrane contains phospholipids and proteins which hold ATP-ase enzymes, NADP carriers, pigments (chlorophyll) and photosystems. Other relevant structural features were also accepted.

Two functional marks would include that the pigments are held in place to facilitate efficient interaction and electron flows; the separation of the fluid inside the thylakoids from that of the stroma creates a system of H+ gradients involving NADP and ATP.

The weaker candidates failed to relate structure to function. Many candidates stated that the thylakoids were located in the mitochondria. Quite a few of the candidates who provided a function, stated involvement in light-dependent reactions.

In Part (b), candidates were required to identify and explain the pathway of an electron within Photosystem I to show how an electron is incorporated into NADP. Approximately half of the candidates showed reasonable competence by referring to the electron acceptor ferredoxin and the existence of the hydrogen ions from the photolysis of water. To gain maximum marks, candidates needed

to make clear, sequential points, such as incident light at 700 nm excites electrons in PS l and an electron is accepted by ferredoxin, which it reduces, on oxidation ferredoxin transfers the electron to NADP, hydrogen ions (protons) from the photolysis of water combine with the electron to form a hydrogen atom which reduces NADP to NADPH.

The weaker candidates failed to show how the H+ is incorporated into the NADP, and neglected to explain that the incident light at 700 nm excited the PS l electron. Several candidates wrote about the Calvin Cycle, again confusing chloroplasts and mitochondria.

Part (c), which tested ecological pyramids posed problems for most candidates who were unable to provide an adequate description, that is, a diagrammatic or quantitative depiction to summarize the path of energy flow and nutrient cycling within a community or feeding chain, to represent feeding relationships or trophic levels. Any appropriate explanation was evaluated for mark-worthiness, but only a moderate number of candidates gained marks. A common misconception was reference to food webs. However, most candidates were able to identify pyramids of numbers, biomass and energy.

Part (d) was well done by all candidates and posed few challenges. Some responses were excellent and referred to solar energy entrapment by autotrophs/primary producers and its conversion by herbivores, (primary consumers), and secondary consumers. The decrease in the transfer of energy at each level was well described.

Module 2

Question 5

In Part (a), most candidates were able to obtain at least half of the marks. However, too many candidates listed the structural features of red blood cells without accurately describing how they enhanced the uptake of oxygen. For instance, the absence of a nucleus creates an opportunity for more space to carry 250 million molecules of haemoglobin. At this level, candidates should be able to give an appropriate description of the biconcave shape of the RBC and desist from using the term ‘donut-shaped’. Most texts clearly explain the many ways in which the red cells are adapted to carry out their oxygen-carrying function efficiently. A number of candidates were unable to relate haemoglobin’s structure to its function. Candidates were confused between the number of molecules that can be carried by one haem group and one molecule of haemoglobin.

In Part (b), the majority of the candidates were unable to gain more than half of the allotted marks. Instead of explaining the Bohr effect, several described the dissociation curve of oxyhaemaglobin, while others displayed a lack of understanding of the concept of the Bohr effect, stating that the dissociation curve shifted to the left during high partial pressure of carbon dioxide. Only a few candidates gave a thorough explanation by mentioning that carbon dioxide combines with water to form carbonic acid. This, on dissociation produces H+ ions which combine with haemoglobin, displacing the oxygen, which is then released to the tissues. However, most of the candidates were able to state that during high partial pressures of carbon dioxide, oxygen was more readily released to the cells.

In Part (c), candidates had a good understanding of the concept of blood glucose regulation and many scored well in this section. There were some who lost marks for the following reasons: (i) explaining the increasing blood glucose levels but not the decreasing levels; (ii) failure to mention the feedback inhibition (check) of insulin and glucagon once a steady state was reached; (iii) confusion between glucagon and glycogen and (iv) erroneously stating that the hormones are released from the liver and are controlled by antidiuretic hormone. Candidates should understand and use correct terms for anabolic and catabolic reactions. Too many made mention of the ‘breakdown’ of glycogen to glucose.

Module 3

Question 6

This question was, in general, poorly done. Few candidates attempted to provide detail in their answers and Parts (c) and (d) were answered mainly in point format.

In Part (a), the more competent candidates scored full marks for a labelled diagram of an antibody molecule. However, many drawings were below the required standard, with incomplete labels and few annotations. Several candidates gave sketches without labels or failed to respond to this section.

In Part (b), many candidates wrote all they knew about B and T cells without really interpreting the question, which referred to 'mature' cells. The maturation processes were not required. Few candidates gave clear distinctions between the roles of B or T cells in humoral or cell-mediated responses to antigen exposure, which was the focus of the question. Frequently the roles were confused and typically candidates linked the T cells to phagocytosis.

In Part (c), the candidates showed that they were not familiar with the critical differences between physical and psychological drug dependence. They needed to address the fact that drug dependence refers to an uncontrollable addiction to a chemical substance, despite the potential for bodily harm; physical dependence is characterized by withdrawal symptoms of a physical nature, nausea, sweating, headaches or loss of balance when the drug is suddenly discontinued; psychological dependence affects behaviour, the yearning for the comfort of a habit, expectation of euphoria, especially following deprivation, with compulsive strategies towards acquisition which may involve lack of reason, confusion or delusion.

In Part (d), liver damage from long-term excessive alcohol consumption includes fatty liver due to deposits of fat in the liver tissue; alcoholic hepatitis, involving inflammation and destruction of tissues; alcoholic cirrhosis, characterized by the replacement of normal hepatocytes and fibrosis, which distorts the internal structure and impedes blood and bile flow. Many candidates, instead of focusing on the liver, substituted information on the effect of alcohol on the heart and blood vessels.

Internal Assessment

General Comments

The overall quality of the Internal Assessment continues to improve, an indication that some of the teachers are doing excellent work, especially with coverage of the syllabus, using a range of activities and innovative approaches.

However, in a number of cases the practical/laboratory activities selected to teach the requisite skills to the candidates, and to make assessments, were sometimes inadequate. Further, the criteria used to evaluate performance were below the appropriate and recommended descriptors. This resulted in candidates being poorly prepared for the questions in the written papers which were based on practical experiences. .

In some cases, the coverage of the syllabus seemed incomplete. Teachers should continue to provide the students with handouts including practice questions to assist in completing the laboratory tasks as well as to explain the procedures. Further it is recommended that students be provided with sample mark schemes and rubrics to inform them of the expected quality of work.