Candidates' Performance

The Biology public examination consisted of two papers. Paper 1 assesses the compulsory part of the curriculum and Paper 2 assesses the elective part.

Paper 1

Paper 1 consisted of two sections, Section A (multiple-choice questions) and Section B (conventional questions). All questions in both sections were compulsory.

Section A (multiple-choice questions)

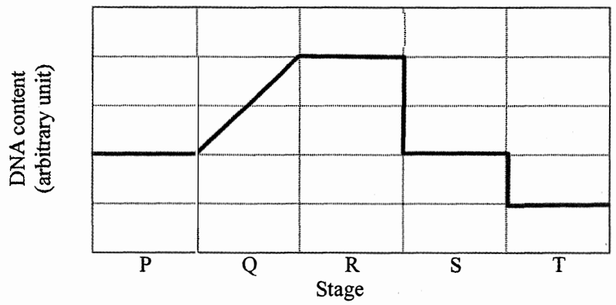
There were 36 questions in this section. Candidates' performance was satisfactory in general and the mean raw score was 21. Some candidates had areas of weakness, however, as revealed by their performance in the following items:

4. Which of the following parts of the nucleotide make up the backbone of a polynucleotide strand?

	A.	sugar and base	(5%)
*	B.	sugar and phosphate	(33%)
	C.	base and phosphate	(23%)
	D.	base, sugar and phosphate	(39%)

Only one third of the candidates were aware that the backbone of a polynucleotide strand was made up of sugar and phosphate. These two constituents are aligned alternately along the strand to form the backbone. The bases (four types) are the variable part that bonds two polynucleotide chains together to form a double helical structure. The sequence of the bases also determines the genetic codes of the organisms.

Directions: Questions 18 to 20 refer to the graph below, which shows the change in the DNA content of a cell undergoing a certain division:

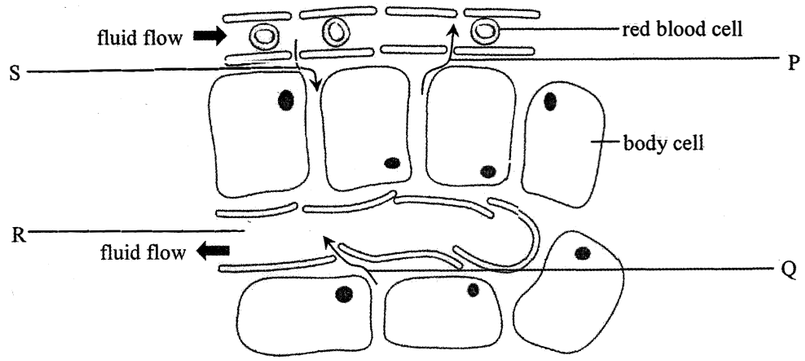


19. Which of the following stages best represent(s) interphase?

	A.	P only	(17%)
	B.	Q only	(33%)
*	C.	P and Q only	(34%)
	D.	P, Q and R only	(16%)

One third of the candidates wrongly thought that DNA synthesis took place throughout the interphase. They were not aware that the interphase includes a resting stage at which the cell grows and functions normally.

Directions: Questions 28 and 29 refer to the diagram below, which shows the cells and the associated vessels in a tissue:



28. Which of the following combinations correctly identifies the major causes of fluid flow represented by P, Q and S?

		P	*Q*	*S*	
	A.	osmosis	diffusion	hydrostatic pressure	(51%)
	B.	hydrostatic pressure	hydrostatic pressure	diffusion	(13%)
*	C.	osmosis	hydrostatic pressure	hydrostatic pressure	(18%)
	D.	diffusion	diffusion	osmosis	(18%)

Only 18% of the candidates chose the correct answer. Most candidates knew that the fluid leaves the blood capillary at the arterial end (as indicated by S) by hydrostatic pressure and drains back into the blood capillary at the venous end (as indicated by P) by osmosis. However, most of them were not aware that the fluid that enters the lymph capillary (as indicated by Q) is also mainly driven by hydrostatic pressure.

Section B (conventional questions)

This section included a wide variety of question types and assessed candidates' basic understanding of biological knowledge and concepts, the application of biological concepts to realistic and novel situations, the scientific enquiry process and communication skills.

Markers considered the paper appropriate with regard to the level of difficulty, and balanced in terms of curriculum coverage.

The following table shows the general performance of candidates in individual questions:

Question Number	Performance in General
1	Well done
2	Satisfactory
3	Fair
4	Good
5	Poor

Question Number	Performance in General
6	Good
7	Poor
8	Poor
9	Poor
10	Fair
11	Fair

1. Well answered. 72% of the candidates scored full marks in this question. Incorrect spelling of the structural parts was common. Some candidates simply stated the function of the structural part instead of describing the difficulty one may face if the structural part is damaged.

2. (a) Well answered. 73% of the candidates were able to give the name of the fluid correctly.

   (b) Satisfactory. Many candidates mixed up the placenta and umbilical cord as well as their functions. Some of them pointed to the umbilical cord as the structure for the exchange of materials but labelled it as the placenta. Others pointed to the placenta but labelled it as the umbilical cord. Spelling mistakes were common.

   (c) Fair. Many candidates gave vague answers or inaccurate descriptions. For example, they stated 'prevent mixing of bloods', 'they are of different blood groups' but failed to point out the consequences if the maternal blood is in direct contact with the foetal blood. Candidates mixed up clumping of blood and blood clotting when they described the mixing of blood of different blood groups. Many candidates wrongly stated that the high blood pressure of maternal blood would destroy the foetus instead of the delicate foetal blood vessels. Some candidates gave short answers such as 'protect against infections' or 'prevent infections' without mentioning the function of placenta as a barrier.

3. (a) Good. Most candidates identified the structures correctly. However, some candidates failed to give the name of structure A but put down 'extension of thylakoid'. Although the question clearly stated that it was an organelle, quite a number of candidates still treated it as a cell and gave wrong labels.

   (b) Satisfactory. Many candidates did not distinguish cell type from tissue. They wrongly gave the tissues instead.

   (c) Poorly answered. Candidates failed to point out the functional relationship between A and B. They simply stated their functions separately.

4. (a) Good. Most candidates made correct observations about the features of the flowering plants. Some candidates had difficulty in identifying the flowers of dead nettle as a cluster of flowers.

   (b) Well answered. About two thirds of the candidates scored full marks in this part. Some candidates did not use the information from the table. They used a negative statement such as the 'the plant does not have a cluster of flowers' instead of 'the plant has a single flower'. Some candidates gave other observations to fill in the key.

(c) Poorly answered. About half of the candidates scored zero for this part. They usually said that the dichotomous key was used for classification rather than the identification of organisms and believed that it was somehow related to evolutionary relationships. Candidates who did not agree with the statement usually focussed on the use of genetic codes or nucleotide sequences for determining the phylogenetic relationship instead of why the dichotomous key could not show the relationship.

5. The question presented an unfamiliar situation based on some data that affect the distribution of the two crab species on a rocky shore. Candidates were required to analyse the data and apply their knowledge to deduce which crab species is more competitive and decide if temperature tolerance is a factor that determines the distribution of the crab species in this scenario. Higher order thinking skills were assessed in this question.

(a) Fair. About 75% of the candidates correctly chose species B as the stronger competitor. However, only half of them linked this with competition for food resources and related it to the high biomass of the lower shore. Most of them were not aware of the fact that a stronger competitor usually occupies the more favourable habitat. Other candidates completely ignored the descriptions about the crab species fighting for food in the simulated habitat and attempted to answer the question using the LT_{50} instead. Many candidates wrongly thought that species A was a stronger competitor because they survived in a habitat with fewer food resources. They demonstrated a poor understanding about how competition works in a natural environment.

(b) Poorly answered. Only half of the candidates correctly pointed out that temperature tolerance was not the determining factor in the distribution of the two crab species. They were able to point out the temperature difference between the middle shore and lower shore. However, when they linked this up with the LT_{50}, they attempted to use the higher LT_{50} of species B as a supporting reason. They were not aware that having a higher LT_{50} did not necessarily mean that it was unfavourable to live in a habitat with a lower mean temperature.

(c) Poorly answered. Candidates did point out that a quadrat was used to study sessile organisms. However, they failed to elaborate on the method itself, which involved the counting of organisms in a confined area.

6. (a) (i) Poorly answered. Candidates were aware that a genetic factor was involved as Kitty and Karen were identical twins. However, they often failed to describe them as 'genetically identical' and did not refer to cancer-causing genes in their answers.

(ii) Well answered. More than two thirds of the candidates were able to relate Kitty's eating habits to her suffering from colon cancer at an earlier age than Karen.

(b) Well answered. The majority of the candidates cited at least one lifestyle that increases the risk of suffering from cancer.

7. (a) Good. About two thirds of the candidates correctly identified cell A as a phagocyte. Spelling mistakes were common. Some wrongly treated it as another type of white blood cell.

(b) Poorly answered. Many candidates simply gave a description of the inflammatory response but did not attempt to select the relevant part to match each symptom. Even if they did, their explanations were usually incomplete. For example, they failed to mention the dilation of arterioles when they accounted for the increased blood flow or failed to mention that the permeability of the capillaries increased when they accounted for the accumulation of tissue fluid. Some candidates made mistakes such as 'capillaries dilate' or 'accumulation of white blood cells makes it swells'.

(c) Poorly answered. Many candidates mixed up the functions of B-lymphocytes and T-lymphocytes in their answers. Some omitted the types of lymphocytes involved in the process. When they mentioned memory cells, they failed to use the term 'differentiate'. Some candidates gave an answer about the secondary response and missed out other actions.

8. The question presented an unfamiliar situation based on a series of experiments that contributed to the discovery of nucleus as the site for storing genetic information. Ideas about scientific investigations and nature of science were assessed in this question. In general, the performance of candidates was unsatisfactory.

(a) Well answered. More than 70% of the candidates scored full marks in this question, showing that they had the basic competence to record the results of the experiment using proper descriptions.

(b) (i) Very poor. Many candidates wrongly thought that the short-lived instruction was DNA, an enzyme or auxin. Only a small proportion of candidates correctly answered RNA in part (1). Some of these candidates pointed out that RNA is involved in protein synthesis but they did not know the proteins produced could affect the morphology of the cap.

(ii) Fair. Most candidates had difficulty relating the design of the experiment to the hypothesis proposed by Hämmerling. As a result, most of them simply described the results about the morphology of the regenerated cap. Some candidates pointed out that the foot of species 2 contained a nucleus for controlling the morphology of the regenerated cap but they often missed the fact that the results also ruled out the possibility that the stalk of species 1 was the site of storage of genetic materials.

(c) Fair. Candidates often gave answers from previous examinations but failed to cite relevant information from the series of experiments as supporting reasons. Some wrongly cited other aspects of the nature of science as their answers. Similar investigations can be found in the teaching packages developed by the Science Education Section of the Education Bureau, namely *Curriculum Resources for Infusing Ideas about Nature and History of Biology and Scientific Inquiry into the Learning and Teaching of Senior Secondary Biology Curriculum* published in 2009, which teachers are encouraged to use.

9. The question was based on an experiment on the study of mineral deficiency on the growth of shoots and roots in terms of dry masses. Candidates were required to analyse the graphs and relate the data to deficiency conditions observed (familiar situation) as well as applying a given hypothesis to explain the differential growth of the shoot and root (unfamiliar situation).

(a) Poorly answered. Many candidates were not familiar with the procedures for obtaining the dry masses of a sample. They missed the important details in their answers, for instance, they gave answers such as 'heat the plant sample' without specifying the temperature required or they did not say that the sample should be weighed repeatedly until there was no further change observed. The practice of giving the exact conditions (temperature used, amount of material used and the duration for a certain treatment etc) in a report is a basic requirement in SBA, and also applies to the written papers.

(b) (i) Well answered. About two thirds of the candidates were aware of the fact that magnesium is required for the formation of chlorophyll, a green pigment that gives the leaves a green colour. Some candidates mixed up chloroplast and chlorophyll.

(ii) Satisfactory. Candidates were aware of the function of chlorophyll and related it to the food production of the plant. However, they were poor at comparing the data presented in the graph. Instead of comparing data from the experimental set-up with data from the control set-up, they simply described the change in the shoot dry mass and root dry mass throughout the experiment and considered it to be increased growth. Some candidates wrongly treated the data as growth rate and wrongly described the results as 'growth is inhibited'.

(c) (i) Fair. Some candidates calculated the numeric difference instead of giving a description of the comparison. As in (b)(ii), many candidates treated the graph as the growth rate and gave wrong interpretations.

(ii) Poorly answered. Despite the fact that the question referred candidates to the shoot dry mass and root dry mass under phosphorus deficiency, candidate failed to observe that the growth was not affected as compared to the growth in a complete nutrient solution (control set-up). As a result, they were not aware that the hypothesis was a possible explanation for such an observation.

10. (a) Well answered. The majority of candidates correctly gave the type of photoreceptors that have abnormal development. However, some candidates just stated the retina as the location where these photoreceptors are most abundant. In fact, cone cells are concentrated at the yellow spot of the retina.

(b) Fair. Candidates made different types of mistakes in their genetic diagrams. Regarding the format, many candidates forgot to put labels (parents, gametes and offspring) or an 'x' between individuals 1 and 2 to indicate the cross. They also forgot to put down individuals 1 and 2. When they gave the phenotypes of the offspring, many candidates gave simple descriptions such as 'normal' and 'normal vision' without referring to colour vision. Many candidates were not aware that they only needed to show the type of gametes produced, i.e. just put down X^r once for individual 2. Some candidates forgot that the cross involved sex linkage and simply put down RR and rr as the genotypes. As a result they scored zero marks for this part. Even though the symbols denoting the alleles were given, many candidates just ignored them and used their own symbols.

(c) Fair. About 40% of the candidates answered this part correctly. Despite the fact that they were requested to use the key of the pedigree to list the possible representation(s) for individual 4, many candidates simply gave the genotypes instead of drawing the representation. Some gave both blank and shaded squares in their answer.

(d) Poorly answered. In handling this question, candidates had to make deductions from observable phenotypes, e.g. as a male (phenotype), David only has one X-chromosome (deduction of genotype), or David has normal colour vision (phenotype) which indicated that the X-chromosome must bear the allele for normal colour vision (genotype). Each deduction in the answer should come with a supporting phenotype observed from the pedigree. However, many candidates jumped to the conclusion that David has one X-chromosome carrying the normal allele for colour vision without showing how they arrived at this conclusion. Many candidates mixed up genes and alleles in their answers. In the third bullet point, some candidates just focused on the allele and forgot to mention that it was located on the X-chromosome from David. Many candidates spent a long time deducing that Daisy was heterozygous. They were not aware that as long as the daughter had the allele for normal colour vision from David, she would have normal colour vision no matter which alleles she inherited from Daisy. Again, many candidates treated it as simple Mendelian genetics and did not score any marks. Candidates should avoid using symbols in addressing genetic questions that require deductions because this can lead to elements being overlooked and a failure to express the deduction clearly.

11. The overall performance was fair. In general, candidates were weak in terms of selecting relevant knowledge and organising it in a structured manner to address the requirements stated in the question. This was reflected in the score awarded for effective communication: about one third of the candidates scored zero marks while less than 10% scored full marks in this case. In fact, many candidates gave straightforward descriptions of the breathing systems in humans and plants separately. They did not select relevant parts and put them together to show their similarities. Candidates are advised to spend some time on planning their essays so that relevant points are organised and presented in a comparative approach as required by the question.

In addressing the requirements about structural adaptations for fulfilling common principles for being an effective gas exchange organ, candidates often remembered the key features but they were inaccurate when they described their respective positions. For example, many candidates noted that a large surface area is an important feature but they referred that to the stomata of the leaves. In fact, stomata are openings for air to flow in and out, i.e. the exchange of gases between plant body (internal environment) and the atmosphere (external environment), rather than the exact location where plant cells take up or give out gases. They should have referred to the loosely packed spongy mesophyll instead, which has more surface exposed than a closely packed arrangement. In the feature about short diffusion distance, many candidates gave imprecise descriptions such as that the air sacs or capillaries are thin. Instead, they should have referred to the walls of the air sacs and capillaries because these are the structures which gases pass through during gas exchange. Some candidates failed to use the term 'water film' in their answers. They simply stated the presence of water inside the air sacs or air space of the leaves. In general, candidates made more mistakes when they described the structures of the leaves than those of the lungs. They were not aware that the thin leaf blade is, in fact, a feature for shortening the distance for diffusion. Candidates should pay more attention to the accuracy of their descriptions with regard to the proper terms to be used, the exact locations involved and the relevance to the requirements.

When candidates attempted to explain why the operation of the breathing system in humans is more effective, many candidates simply gave a plain description of the breathing movements involved. They failed to point out that active ventilation is a human characteristic while plants rely on passive diffusion. Some candidates talked about how the circulatory system works with the breathing systems, which was irrelevant in this case.

Paper 2

Paper 2 consisted of four sections. Section A contained questions on 'Human Physiology: Regulation and Control', Section B on 'Applied Ecology', Section C on 'Microorganisms and Humans' and Section D on 'Biotechnology'. Candidates were required to attempt all questions in two of the sections.

The following table shows the general performance of candidates and the popularity of each section:

Question Number	Popularity %	Performance in General
1(a) 1(b)	94	Satisfactory Poor
2(a) 2(b)	64	Fair Poor
3(a) 3(b)	13	Poor Poor
4(a) 4(b)	29	Poor Satisfactory

Section A

1. (a) (i) Well answered. About 70% of the candidates answered this part correctly. Candidates should not have used 'directly proportional' or 'inversely proportional' in their answers when the data were presented in a table form and where the mathematical relationship of the variables were not established. They should simply have stated the trend observed.

(ii) (1) Poorly answered. Many candidates were not aware that glycogen is the food store in muscles. They drew a flowchart that began with glucose. Some candidates failed to indicate ATP production in their flowchart. Quite a number of candidates gave the chemical pathway instead.

(2) Good. Quite a number of candidates simply mentioned that the athletes needed more oxygen and then elaborated on the use of oxygen for metabolising the lactic acid produced. They were not aware that the phenomenon of breathing rapidly after exercise would, indeed, bring in more oxygen.

(iii) Fair. Many candidates missed the point that stimulation of the sympathetic nervous system would result in more nerve impulses being sent out. They were not aware that nerve impulses were sent from both the sympathetic nervous system and the parasympathetic nervous system to maintain the heartbeat and breathing under normal circumstances. Some candidates failed to mention clearly the physiological changes. They did not distinguish between breathing rate and breathing depth, or between heart rate, stroke volume and cardiac output in their answers.

(b) (i) Satisfactory. Candidate usually gave clear descriptions of the changes in the rate of reabsorption and excretion of glucose but many of them forgot to mention plasma glucose concentration as a reference for the turning point. Some candidates neglected to mention the part about glucose excretion in their answers.

(ii) (1) Good. Most candidates correctly pointed out that it was the first coiled tubule.

(2) Poorly answered. This part was very demanding for candidates as it involved a novel situation. Candidates were required to integrate the new piece of information (increased expression of the gene coding for membrane glucose carrier) and relevant concept about glucose reabsorption (reabsorption is done by active transport) to synthesise a possible explanation to account for the higher glucose reabsorption capability of the type II diabetic patient. Only a small

proportion of candidates pointed out that there would be more glucose transporters in the first coiled tubule of the type II diabetic patient.

(iii) Poorly answered. Many candidates attempted to provide explanations using the ADH. In fact ADH only increases the permeability of the collecting duct to water. Under normal circumstances, more water is reabsorbed into the blood because urine has a higher water potential. However, candidates were not aware that a large amount of glucose was excreted together with urine in this case and the water potential of urine was much lower than normal, and hence the amount of water reabsorbed, whether in the second coiled tubule or collecting duct, would be much lower.

Section B

2. (a) (i) Fair. Many candidates did not fully understand the meaning of biochemical oxygen demand. Some mistook it for the amount of dissolved oxygen in water. As a result, they gave a wrong explanation. Many candidates thought that the domestic sewage from the residential area contained mainly inorganic waste instead of organic. They tried to use, for their answer, the growth of algae and how this depleted oxygen in water at night. They simply repeated answers about algal bloom from past examinations without paying attention to the information and data presented in the question.

(ii) Satisfactory. Candidates were aware that the health risk was due to bioaccumulation of heavy metals along the food chain but they gave either a vague or a wrong explanation. For example, some candidates wrongly thought that fish absorb heavy metals directly from water or wrongly said that heavy metals could not be 'digested' or 'egested'. They did not know that the heavy metal was absorbed into the blood during absorption of food and taken up from blood by body cells. Once taken in, the body cells cannot metabolise or excrete it, and therefore it would accumulate in the body tissues of the organisms. Some candidates continued to use algal bloom as an explanation here and thought that it was the toxins in algae that accumulated in the fish.

(iii) (1) Poorly answered. Only one third of the candidates pointed out that the antibiotics came from human excreta. Others wrongly thought that the antibiotics were produced by bacteria or fungi in the sewage while others thought the antibiotics were added to water to kill bacteria.

(2) Poorly answered. Many candidates simply stated that bacteria would develop resistance to the antibiotics without elaboration on the disturbance to the ecosystem. Again, some candidates wrongly treated antibiotics as fertilisers and thought that they would cause algal bloom.

(b) The question was based on an unfamiliar situation about the study of crops growing in arsenic polluted soils. To candidates it was a demanding question as it involved the study of more than one independent variable (uncontaminated soil versus arsenic-contaminated soil; and the addition of phosphate to both types of soil) and the analysis made reference to the uncontaminated soil without phosphate addition.

(i) Poorly answered. Many candidates lost marks because they simply compared the dry masses of the grains and plant body instead of growth. They were not aware that a higher dry mass means that the part grows better.

(ii) Very poor. Again, candidates mainly focussed their comparison on the dry masses without relating this to the growth of wheat. Many of them simply compared the dry masses of grain and plant body but did not refer to the two types of soil, despite the fact that a hint had already been given. They treated them as separate cases when they gave their comparison. Many candidates simply repeated the data and did not attempt to integrate the comparisons to reach a conclusion.

(iii) Fair. Some candidates only stated whether the percentage of arsenic in the grains or plant body was higher or lower in the two types of soil. They failed to relate such changes as an effect of phosphate addition that altered the arsenic distribution in the wheat.

(iv) Poorly answered. Many candidates simply stated that the growth of the wheat was improved. They failed to link this up with the productivity or the yield. Moreover, they lacked the knowledge that only grains are the edible part for humans. As a result, they failed to mention that the reduced uptake of arsenic in grains would lower the health risk.

Section C

3. (a) (i) Poorly answered. Although many candidates did refer to the fact that part of the sushi was uncooked, they seldom made reference to the presence of microorganisms.

(ii) Well answered. Most candidates pointed out that the lower pH condition of vinegar could inhibit the growth of *Bacillus cereus*.

(iii) Poorly answered. Only a small proportion of the candidates listed a workable procedure. However, some candidates missed the details when they described the procedures, such as a fixed amount of stock for each pH condition and the time for incubation. Some candidates attempted to use an agar plate for culturing and counting bacterial colonies for measurement. However, they were not aware that serial dilution should be done to the stock solution in this case and the culture solution should be spread over the surface of the agar evenly. They wrongly used an inoculating loop instead of a spreader in their procedure.

(iv) Poorly answered. Many candidates were not aware that a suitable temperature and sufficient time were the two factors that allowed for the multiplication of bacteria, thereby increasing the chance of food poisoning if the plates were circulating along the belt for a long enough time.

(b) (i) Satisfactory. Candidates did well in the part about describing the changes in the dry mass of food and microorganisms. However, some of them failed to provide proper explanations for the changes.

(ii) (1) Poorly answered. Many candidates just listed out the dry mass of food waste and microorganisms on day 0 and day 50 separately instead of stating the total dry mass.

(2) Poorly answered. Many candidates thought that the decrease in the total dry mass was due to energy lost or the death of microorganisms. They were not aware that decomposition involved the production of gases which left the compost.

(iii) Good. Most candidates pointed out that the compost could be used as fertiliser.

Section D

4. (a) (i) Fair. Candidates usually stated the function of neurones or neurotransmitters but failed to relate the possible role of the neurotransmitters in conveying the nerve signal for muscle coordination.

(ii) Poorly answered. Many candidates were aware that the drugs could substitute the role of neurotransmitter but they were not aware that it worked by binding to the receptor site on the membrane of the next neurone. Many candidates thought that it acted on the neuromuscular junction instead of synapses in the brain.

(iii) Fair. Candidates were aware that the stem cells were capable of differentiating into neurones but many of them failed to use the proper terms in their answers. They used simple words such as 'change to' or 'form' instead of 'differentiate'. They usually forgot to mention that the production of neurotransmitters was resumed once these new neurones were operating.

(iv) Poorly answered. Many candidates were not aware that 'aborted' foetal tissues were used and they gave answers such as it involved the sacrifice of life. They did not know the foetus was already dead before they took the tissue. Some candidates were aware that skin cells were capable of dividing rapidly but they wrongly thought that this would allow them to differentiate into many types of cells.

(b) (i) Good. Candidates were familiar with the steps. About 40% of the candidates scored full marks in this part. Some candidates gave a wrong name to the enzymes involved, such as restricted or restrictive enzymes instead of restriction enzymes, and lipase instead of ligase. Some used the wrong type of enzyme, such as DNA polymerase.

(ii) (1) (I) Well answered. About 70% of candidates gave the correct answer in this part.

(II) Well answered. About 80% of candidates gave the correct answer in this part.

(III) Fair. Many candidates thought that the homozygous dominant (BB) and heterozygous (Bb) would be equally abundant in the non-*Bt* areas. They did not pay attention to the key information that the mutated allele (b) was very rare in the pest population.

(2) (I) Poorly answered. Many candidates attempted to answer this question using the concept of isolation without noting that the areas were in contact and the adult forms of the pests had greater mobility to reach other areas for breeding. Some candidates wrongly thought that *Bt* resistance pests would have no survival advantage when normal crops were grown and would be eliminated. In fact, only disadvantaged traits would be selected against during natural selection.

(II) Poorly answered. Only a small proportion of candidates gave a valid assumption for this strategy.

General comments and recommendations:

Generally, candidates did well in short and straightforward questions that required recall of biological knowledge. They were able to reproduce textbook materials or answers from previous exams. However, when they answered questions that required detailed reasoning and explanation, they often gave fragmented pieces of information with vague descriptions that often missed some crucial elements [e.g. Paper 1 Q.2(c), Q.3(c), Q.7(b)&(c) and Q.9(a); Paper 2 Q.1(a)(iii) and Q.3(a)(iii)]. They tended to use simple words which often failed to express the specific meanings that only technical terms convey [e.g. Paper 1 Q.3(a), Q.7(c) and Q.11; Paper 2 Q.4(iii)]. When it comes to the use of specific terms, candidates often mixed up their meanings [e.g. Paper 1 Q.2(c), Q.9(b)(i), 10(d) and Q.11; Paper 2 Q.1(a)(iii) and Q.2 (b)(ii)]. Spelling mistakes were common. Candidates should pay more attention to the use of terms, the meanings of the specific terms and their spellings, as this would eradicate many careless mistakes.

Candidates were weak at handling questions involving scientific reasoning, such as causal relationship, logical deduction, hypothesis making and drawing conclusion [e.g. Paper 1 Q.5(a)&(b), Q.8(b)(i)&(ii), Q.9(c)(i)&(ii), Q.10(d) and Q.11; Paper 2 Q.2(b) and Q.4(b)(ii)(2)]. Candidates were able to handle the description of numeric data competently but failed to state the meaning of the trend according to the aim of the study or investigation. For instance, they only referred to the increased dry mass but failed to describe it as improved growth [Paper 2 Q.2(b)]. In this case, candidates failed to recognise that the numeric data was a measurement representing an

abstract dependent variable. Therefore, they needed to refer to the dependent variable instead of its measurement when they drew conclusions from the data set. Moreover, candidates' understanding about the roles of hypothesis in scientific investigations was unsatisfactory. A hypothesis is a proposed explanation for a certain observation [Paper 1 Q.9(c)] and it can be verified through collecting data from a carefully designed experiment [Paper 1 Q.8(b)]. In both cases, candidates had difficulty in fulfilling the requirements of the questions. This coincided with the fact that many experiments done in SBA were simple ones that did not involve a hypothesis. Training in hypothesis making, experimental design, analytic skills for data interpretation and deduction should be strengthened. This could be achieved by exposing candidates to a wider range of experiments at different levels of difficulty. Emphasis should be put on the use of a control experiment, how to compare data and identify trends, and on the language used in comparison, making deductions and reporting. It is only through constructed learning activities that these essential skills can be imparted.

In the assessment of Biology, scenario-based questions with daily life examples are often used to assess candidates' ability to apply biological concepts and principles. In these cases, candidates should pay attention to the details given in the questions and think thoroughly about the situation involved with the help of their daily life experience. Sometimes, candidates seemed to be so absorbed in the biological details that they forgot about common sense. For instance, many candidates mistakenly thought that a temperature cooler than the LT_{50} would kill the crabs in Q.5 of Paper 1. When they discussed the breeding of the adult pests in Q.4(b) of Paper 2, they did not seem to know that the adult form of the caterpillar is the butterfly. As a result, they wrongly interpreted that isolation would result.

School-based Assessment

All school candidates sitting for HKDSE Biology Examination have to participate in School-based Assessment (SBA). A total of 14,718 Biology students from 438 schools submitted their SBA marks this year. The schools were divided into 24 groups and the implementation of SBA by the teachers in each group was monitored by a District Coordinator (DC). The DCs were also responsible for reviewing the samples of students' work which were submitted.

The statistical moderation method was adopted to moderate the SBA scores submitted by schools. Outlier schools after statistical moderation were identified for further follow-up by the SBA Supervisor. 71.5% of schools fell into the 'within the expected range' category, while 17.1% of schools had marks higher than expected, and 11.4% of schools had marks lower than expected. However, among the schools with marks higher or lower than expected, the majority only deviated slightly from the expected range. These figures seem to indicate that the majority of the teachers had a good understanding of the SBA requirements, and that the marking standards were appropriate. However, a number of schools had moderated SBA scores which were significantly higher or lower than their raw scores, which indicates that the marking standards of the teachers concerned were either too strict or lenient as judged by the supervisor and the DCs. Teachers should pay due attention to this discrepancy and adjust their marking standards in the future.

Some schools were visited by the DCs to gather first-hand information on the implementation on the Scheme in schools. According to the feedback of teachers and the DC's reports, the assessment process was smooth and effective in general. SBA marks were submitted on time and all requirements were met. The major observations on this year's SBA are:

Some students did not have a good understanding of the role of a control in the investigation and how to draw a sound conclusion based on the data. In an investigation about why fresh fruit juices would prevent jelly from setting, a student added fresh juice, boiled juice and water into different beakers of gelatin. However, the student only considered water as a control but not the boiled juice. In the discussion, the results were explained directly: 'the jelly with fresh juice added failed to set because the protease digested the gelatin... the jelly with boiled juice added could set since the enzyme had been denatured by boiling.' A better one should be:

> *Comparing the results of the gelatin with fresh juice and water, we found that fresh juice can inhibit jelly setting. This may be due to substances present in the juice or its acidity. When comparing the results between the gelatin with fresh juice added and those with boiled juice added, we found that boiling can destroy the ability of the fruit juice to inhibit jelly setting. These results rule out acidity and other heat resistant substances in the juice as the cause of setting inhibition. We know that some fruit juices like kiwi and papaya contain an enzyme, protease, that can digest gelatin, which will be denatured by boiling. The results thus support the conclusion that it is likely to be the protease in the fruit juice that inhibits jelly setting through digesting the gelatin in the jelly.*

Comparing the above with the student's, we can see that: (1) the student did not combine the data of the experimental and control set-ups in making their interpretation, but explained them separately; (2) the student did not realise the different roles of multiple controls: the role of water is to test if fruit juice can inhibit jelly setting, while the role of boiled juice is to test if heat sensitive substances are involved; (3) the student jumped directly from the data to the conclusion - from the observations that fresh juice inhibited jelly setting while boiled juice did not to the conclusion that it was caused by protease in the juice. The data, however, only point to some heat-sensitive substances in the fruit juice as the cause of setting inhibition. This would need further theoretical consideration prior to reaching the conclusion - some enzymes being heat sensitive, some fruit juices having protease, etc. The conclusion is never certain given its inferential nature. This kind of theory data coordination and tentative expression are not common in students' reports. The difference is subtle but significant. Students also seemed confused about what conclusions the data support and how the data can be explained.

There is a practice that students are first asked to write out the experimental design and procedure on their own and then provide a full, standard procedure to conduct the experiment. It is advised that teachers can explain to students the principles behind the procedure and allow them to modify the 'standard' procedure at their discretion. To go further, if time and resources permit, teachers may consider leading a class discussion on each group's design without disclosing the standard procedure. During the discussion, some major problems with students' design can be pointed out and corrected. Then students can be allowed to work on their own design and procedure.

This practice not only prompts students to think about their design and procedure carefully and thoroughly, but also gives them a greater ownership of the investigation.

The number and types of investigations are similar to past years. While more complex investigations are preferred, simple investigations can also effectively foster scientific reasoning and an understanding of the nature of science, when it is open in its design, procedure and discussion. For instance, in an investigation about the effect of light intensity on photosynthesis, there are many ways to manipulate the light intensity, including distance of the table lamp, power of the light bulb, and covering the plant with translucent paper, etc. There are also many different experimental designs: within-subject design which subjects the same plant to varying light intensities; between-subject design that uses different plants for different treatments, or different leaves of the same plant, and so on. The outcome variable can also be oxygen produced rather than starch in the leaves. When students are given room for a thorough discussion of these considerations, particularly through critical peer review, fruitful learning can be achieved. .

Students should complete the assessment tasks honestly and responsibly in accordance with the stipulated requirements. They will be subject to severe penalties for proven malpractice, such as plagiarising others' work. The HKDSE Examination Regulations stipulate that a candidate may be liable to disqualification from part or the whole of the examination, or suffer a mark penalty for breaching the regulations. Students can refer to the information leaflet HKDSE Examination Information on School-based Assessment (http://www.hkeaa.edu.hk/DocLibrary/Media/Leaflets/SBA_pamphlet_E_web.pdf) for guidance on how to properly acknowledge sources of information quoted in their work.

Acknowledgements

Material from the following web-site has been used in question papers in this volume:

2016

University of Wisconsin Plant Teaching Collection	*Image: Chloroplast-microbodies* http://botit.botany.wisc.edu/Resources/Botany/Plant%20Cell/Electron%20Micrographs/Plastids/Chloroplasts/Chloroplast-microbodies.jpg.html

The Authority is grateful to publishers/organisations for permission to include in the question papers material from their publications. We apologise for any infringement of copyright in respect of material printed in this volume, for which permission has not been obtained in time or for which the sources could not be traced.

Every effort has been made to trace copyright. However, in the event of any inadvertent infringement due to errors or omissions, copyright owners are invited to contact us so that we can come to a suitable arrangement.