## Candidates' Performance

The 2015 DSE Biology Examination was based on the Biology Curriculum (S4-6) implemented in 2009. The Biology public examination consists 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 23.

Some candidates had areas of weakness, however, as revealed by their performance in the following items:

9. Which of the following combinations correctly describes the absorption of water in the alimentary canal?

| | | *Occurs mostly in* | *Major reason* | |
|---|---|---|---|---|
| | A. | ileum | it is the longest part of the digestive tract | (23%) |
| * | B. | ileum | most digested food is absorbed in this region | (36%) |
| | C. | large intestine | its function is water absorption | (29%) |
| | D. | large intestine | absorption of food has completed in this region | (12%) |

About two-fifths of the candidates wrongly thought that water absorption occurs mostly in the large intestine. Despite the fact that water absorption is the major function of the large intestine, most water is absorbed in the ileum. Only 36% of the candidates were aware that the absorption of digested food creates a steep concentration gradient of water potential and draws water in.

19. Which of the following can be the functions of roots in flowering plants?

(1) anchorage
(2) absorption
(3) vegetative propagation

| | | | |
|---|---|---|---|
| | A. | (1) and (2) only | (51%) |
| | B. | (1) and (3) only | (1%) |
| | C. | (2) and (3) only | (8%) |
| * | D. | (1), (2) and (3) | (40%) |

Half of the candidates forgot that some plants can carry out vegetative propagation that makes use of any vegetative parts to reproduce a clone. In the learning and teaching of Biology, knowledge is often grouped into topics by body systems or functions. In this case, candidates learnt about the functions (support, nutrition and reproduction) in different topics but they forgot that some plant organs can perform multiple functions. This may show that candidates treated them as discrete facts and failed to integrate the knowledge learned.



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***Directions:*** Questions 32 and 33 refer to the table below, which shows the results of blood tests for the presence of antigens and antibodies of hepatitis B in four individuals:

| | Individual 1 | Individual 2 | Individual 3 | Individual 4 |
|---|---|---|---|---|
| Antigens of hepatitis B | Negative | Positive | Negative | Positive |
| Antibodies of hepatitis B | Negative | Negative | Positive | Positive |

32. Which individual(s) would you recommend for vaccination against hepatitis B?

* A. 1 only (39%)
B. 4 only (9%)
C. 1 and 2 only (41%)
D. 1 and 3 only (11%)

Most candidates understood that Individual 1 required vaccination as both antigens and antibodies of hepatitis B were absent from the blood tests. However, more than half of the candidates did not know the presence of antibodies against hepatitis B indicated that Individual 3 had previously been exposed to the antigens and had recovered.

**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 enquiry process of science 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 | Fair |
| 3 | Fair |
| 4 | Good |
| 5 | Fair |
| 6 | Poor |
| 7 | Fair |
| 8 | Good |
| 9 | Fair |
| 10 | Good |
| 11 | Good |



1. Well answered. About two-thirds of the candidates scored full marks for this question, showing that they were able to recall simple facts correctly. Some candidates did not know the function of the Eustachian tube while some candidates wrongly thought that the ear bones were responsible for converting sound waves into vibrations.

2. (a) Well answered. About 75% of the candidates were able to identify structure X as a chromatid / chromosome and spelt the word correctly. Others gave wrong spellings such as 'chromotid' or wrongly labelled it as chromatin.

(b) Fair. About two-thirds of the candidates correctly identified the stage. However, most of them failed to relate the occurrence of transcription to the dispersed chromatin as shown in the cell at stage A. This showed that candidates were not aware that the dispersed condition of the genetic materials allows unwinding of DNA to single strand for transcription. They showed a poor understanding of how the genetic materials are packed and stored.

(c) Poorly answered. About half of the candidates correctly gave the reason that contributed to the difference in the number of daughter cells produced in the two cell divisions. However, only 10% of the candidates explained how the difference in the chromosome sets is brought about. They thought that the 2N and 1N represent 46 chromosomes and 23 chromosomes respectively. They were not aware that the chromosomes exist in homologous pairs while 2N represents two complete sets of chromosomes and 1N represents one set. Candidates were weak at distinguishing between chromatin, chromatid, chromosomes and homologous chromosomes and used them interchangeably in their answers. Some gave an account of the cell division processes or the importance of having haploid cells in gamete production, which were irrelevant.

3. (a) Well answered. About 80% of the candidates correctly chose the shortest food chain from the food web. Some candidates did not use arrows to show the direction. Some candidates gave a food chain that started with consumer instead of producer.

(b) Well answered. About 70% of the candidates produced the number of pyramids with the correct shapes and labels. Some candidates did not pay attention to the scale and drew a very wide top level, showing that they were not aware that the number of top consumers should be very few as compared to the producer. As a result, they lost the mark attributed to drawing. Some drew an inverted pyramid.

(c) Poorly answered. Most candidates failed to fully explain why it is an upright pyramid. Many candidates did not know that the size of organisms at each trophic level plays a role in determining the shape of the pyramid. They usually attempted to explain the shape using the concept of energy lost along the food chain. However, some only mentioned that there is energy lost due to respiration but did not mention that the energy available to the next trophic level is therefore lowered. Some simply gave a description of the shape and did not offer an explanation at all.

(d) Poorly answered. Only a minority of candidates gave two practical methods of studying the feeding relationship. More than half scored zero marks in this question. Candidates often missed some important descriptions in their answer, e.g. studying the organisms or counting the number of organisms. Some candidate did not understand the question and gave irrelevant answers such as how to conserve the aquatic ecosystem.

4. (a) Well answered. About 90% of the candidates answered correctly.

(b) (i) Well answered. About 75% of the candidates scored full marks for this question.

(ii) Well answered. About 75% of the candidates scored full marks for this question. Some candidates did not use the symbols given to answer the questions, such as using 'I' instead of 'i' for producing red blood cells with no antigens on their surface.



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(c) Poorly answered. Most candidates pointed out that there will be an immune response if the blood types did not match. However, they failed to provide clear and logical explanations. Many candidates did not know the presence of antibodies in the blood if one does not have the respective antigen on the red blood cells. As a result, they treated it as a normal immune response and gave answers such as the production of memory cells. Many candidates failed to point out that the immune response would lead to the formation of blood clots.

5. (a) Good. About 80% of the candidates correctly pointed out that R was a motor neurone. However, only one-third of them provided a valid supporting reason. Some were aware that it is connected to muscle fibres but failed to point out that muscle is an effector. Most of them simply recited the features of a motor neurone, such as a longer axon, but these could not be judged from the photograph. When dealing with questions involving interpretation of a photograph, candidates should pay attention to the features shown only and choose relevant features to address the question.

(b) Poorly answered. Many candidates identified S as mitochondrion but failed to identify T as vesicle. Even if they identified them correctly, they gave their functions separately. They were not aware that the energy from S was used in the synthesis of chemical messengers in T.

(c) Fair. Many candidates gave a very simple description stating that T moved across the synapse and produced a signal at the muscle fibre. They treated T as a chemical messenger rather than a vesicle. As a result, they missed the description of the fusion of T with the membrane to release chemical messengers into the synapse. Furthermore, many candidates did not mention that the chemical messengers move across the synapse by diffusion. Finally, many candidates treated it as a normal synaptic connection and did not realize that electrical signals will be generated and transmitted to the muscle fibres.

6. The question was on an unfamiliar situation based on some historical development of the understanding of the structure of cell membrane. Candidates were required to relate the findings of each scientist to the construction of the cell membrane models and the orientation of the components in the cell membrane. Finally, candidates' understanding of the nature of science was assessed.

(a) Good. About 60% of the candidates pointed out that the component is phospholipid. Others gave answers such as lipids, glycerol or fatty acids. They did not pay attention to the findings of Langmuir that the component exhibited both water-loving and water-hating properties.

(b) Poorly answered. Candidates were very weak at giving an accurate description of the orientation of the phospholipids in cell membranes and made mistakes such as wrongly matching the water-loving and water-hating parts with the tail and head of the phospholipid, wrongly stated that the water-loving heads were pointing inward, and failed to distinguish between the inner part and outer part of the cell membrane. Candidates who correctly described the orientation of the phospholipids failed to relate this to the presence of an aqueous medium inside and outside the cell membrane.

(c) (i) Well answered. About 75% of the candidates correctly identified this component as protein.

(ii) Poorly answered. Candidates had difficulty in describing the arrangement of the proteins in the cell membrane. Some candidates pointed out that some proteins exist as surface proteins while other proteins exist as transmembrane proteins. However, they failed to further elaborate that the fluid nature of the membrane results in an asymmetric distribution of these proteins.

(d) Poorly answered. About half of the candidates elaborated on how experimental findings provided empirical data for identifying the major components for the construction of the cell membrane models. However, only some candidates understood that the scientific models also required input from imagination on how the components were put together in a three-dimensional manner, and these inputs could be proved wrong with more findings and discoveries later on. Candidates gave very vague answers and failed to incorporate the events in their elaborations.



7. (a) Good. About 70% of the candidates were able to name an organ which contains a large amount of catalase while about half of the candidates failed to provide an explanation for their answer. This was probably because most textbooks include the experiment demonstrating the presence of catalase from various animal and plant tissues. Candidates were able to draw from their experience gained from practical sessions in schools and chose the right organ. However, they were unable to link this experience with the function of the organ.

(b) Very Poor. Most candidates were not aware that the temperature of the reaction was the independent variable and therefore it was important that the catalase and hydrogen peroxide solutions should reach the desired temperature before mixing. Instead, they gave answers such as 'setting up a control experiment' and 'waiting for the equilibrium of the reaction' which were totally irrelevant in this case. This reflected that candidates were not aware of the aim of the investigation and were very weak about the manipulation of the variables in scientific investigations.

(c) Fair. Although there were many set-ups that were applicable in this case, many candidates gave set-ups which were not feasible. They either failed to collect the gas released or failed to give measurements. Some candidates used apparatus which was not provided while some other candidates were not aware that they could choose only some items for the set-up. Some just recited other set-ups, such as the collection of oxygen from water plants. In general, the quality of drawing for the set-up was poor. Some candidates just drew a box to represent the apparatus. Some drew 3D diagrams in their answers. In this case, a 2D diagram showing the shape of the cross section of the apparatus serves the purpose. It is advised that more practice regarding experimental design and the drawing of set-ups should be provided when teaching scientific investigations.

8. (a) Well answered. About two-thirds of the candidates were able to identify the type of diabetes correctly.

(b) (i) Good. Candidates tended to give the functions of insulin in the homeostatic regulation of blood glucose level without specifically referring to Lisa's blood test results and the diabetic condition. As result, they failed to score full marks. Some candidates just reiterated the results presented without integrating the significance of the results in their answers. Many candidates mistakenly stated that insulin directly converted glucose to glycogen. It should be stressed that insulin is a hormone that binds to the receptors on the membrane of the liver cells / muscle cells and provokes a cascade of cellular activities. These activities include the increase in the uptake of glucose from the blood as the first step, followed by an increase in glucose metabolism such as an increase in glucose oxidation and increase in conversion of glucose to glycogen. In this case, the increased uptake of glucose from the blood will have a direct impact in the drop in blood glucose level. However, many candidates only focused on the discussion of the reactions and failed to account for the inability to lower the blood glucose level even after fasting. Some candidates incorrectly gave the liver or pituitary as the site of production of insulin.

(ii) Fair. Similar to (b)(i), many candidates just gave a direct recall of the function of glucagon without referring to the data given. Some candidates mixed up glucagon with glycogen and gave an explanation which was totally irrelevant. Some candidates incorrectly stated the liver or pituitary as the site of production of glucagon.

(c) Good. About 90% of the candidates stated at least one dietary habit for diabetic patients. However, many candidates overlooked the fact that the recommendations should be made specifically for dietary habits. As a result, they gave irrelevant answers such as regular exercise and injection of insulin.



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9. (a) Poorly answered. Most candidates simply stated the turgidity of the mesophyll cells / thin-walled cells supported the plant. Some of them failed to use the correct terms in their descriptions or did not state clearly the type of cells related. Only a small proportion of the candidates were aware that the presence of xylem in the network of veins running through the leaf surface could also provide rigidity to support the leaves. Candidates should avoid using the term 'mechanical support' because both rigidity and turgidity will contribute to the support of the plant mechanically.

(b) Poorly answered. Many candidates failed to provide a clear and logical explanation. Although they were aware of the fact that transpiration played an important role in determining the appearance of the plant at 1pm, they simply reiterated the process of transpiration without any adjustment to take into account the conditions presented in the scenario. Some candidates wrongly thought that increased photosynthesis at 1 pm would lower the transpiration rate and hence water absorption.

(c) Fair. Many candidates failed to refer to the difference in the appearance of the leaves in the two photographs in their answer. They simply mentioned that the leaves in photograph X had a larger surface area. In fact, the surface areas of the leaves were the same since the two photographs showed the same plant with different appearances. There should have been descriptions of the appearance, i.e. whether the leaf blade was fully extended or not. Only some candidates were aware that leaves are supported and oriented in a way that their surfaces were facing the light source for light absorption. This reflected that candidates often failed to note and describe the observable differences shown and did not apply the knowledge learned in real life situations.

10. The question involved an unfamiliar situation based on a classical example of evolution due to geographical isolation. Candidates were required to analyse the information provided in the preamble and apply the knowledge about evolution and speciation to address the questions that followed.

(a) Good. About half of the candidates managed to get full marks in this question. However, quite a number of candidates forgot to label the ancestor in the evolutionary tree. Many candidates gave the evolutionary tree in different forms: some resembled a dichotomous key used in classification, some did not indicate the timeline, and some showed unknown branches which were not labelled.

(b) Poorly answered. Many candidates simply reiterated information about separation of continents and migration of camels but failed to identify the situation as an isolation of animal groups which stopped the gene flow between the groups. When they explained how different traits resulted, they simply referred to a change in the environment rather than the fact that each animal group was facing a different set of environmental factors due to their locations in different geographical regions. Some candidates did not attempt to use genetic materials to talk about inheritance. They simply stated that the traits were passed on to the next generation. Finally, when they described the speciation, they gave superficial answers such as 'they failed to reproduce' rather than using specific terms such as 'interbreed'. Some candidates just wrote down textbook-type materials about natural selection and evolution or answers from past examinations to address this question, which were irrelevant.

(c) Poorly answered. Candidates gave very simple answers such as 'compare their DNA' or 'check the DNA sequence'. In fact, they should specify that comparisons of some essential proteins were made specifically, be they the DNA sequence or amino acid sequence.

(d) Good. More than half of the candidates gave at least one limitation of the use of fossil records as evidence for evolution. Candidates often mixed up the terms 'fossils' and 'fossil records' in their answers, e.g. they gave answers such as 'fossil records are located in inaccessible areas' or 'fossil records are destroyed' which should have referred to the fossil itself rather than fossil records. Some gave very simple answers such as 'it is difficult to find the fossils' without referring to the actual reason.



11. The overall performance was good. In general, candidates were well-aware of the structures of arteries and veins and how blood flows through the blood vessels. However, their ability to organize these facts and present them in a related and coherent manner varied considerably. A small proportion of more able candidates (about 20%) were able to present the structural differences followed by the different ways of maintaining blood flow. As a result, they scored full marks for communication. However, the majority of candidates gave discrete descriptions of the structure of arteries and veins without comparison or gave two separate descriptions of the blood flow in arteries and veins. They were awarded the content marks but lost the marks for communication (about 40% scored 2 marks and 25% scored 1 mark). Candidates are advised to spend some time on planning such that content points are organized and presented in a manner that addressed the requirements of the essay.

In addressing requirements about structural differences, candidates are advised to use comparative terms and one adjective at a time. For instance, descriptions such as 'thick elastic muscular wall for withstanding high blood pressure' should be avoided because it would be difficult to judge which type of tissues (elastic tissue or muscle) was being compared or related to the significance of withstanding high blood pressure. In fact, many candidates wrongly paired up the types of tissues and the significance in their answers, e.g. 'thicker muscular wall of arteries' should be paired with 'blood flow was maintained by high blood pressure driven by the pumping of heart', while 'elastic tissues of arteries' should be related to the 'recoil of wall along the arteries'. However, candidates often confused the significance of the muscular wall and elastic tissues. One way to develop students' awareness of the function or significance of various tissues of blood vessels is to require them to draw diagrams of the two types of blood vessels showing the relative proportions of different tissues and ask them to annotate the significance of these tissues.

Some candidates gave irrelevant answers such as 'arteries carry oxygenated blood while veins carry deoxygenated blood', or compared the colour of blood in the blood vessels. Sometimes, candidates gave contradictory descriptions. In these cases, no mark was awarded. Some weaker candidates failed to use the correct terms in their essay. For example, they mixed up the walls of blood vessels with cell walls, thick walls with thick muscular walls, and diameter with lumen. Some mixed up the features of the veins and capillaries.

**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) | 96 | Good |
| 1(b) | | Poor |
| 2(a) | 64 | Fair |
| 2(b) | | Poor |
| 3(a) | 9 | Poor |
| 3(b) | | Poor |
| 4(a) | 31 | Poor |
| 4(b) | | Good |



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**Section A**

1. (a) (i) Good. More than 80% of candidates gave at least one item. Some candidates wrongly thought that the presence of sperms was an indication of fertility. They were not aware that a low sperm count was a cause of infertility in men. Many candidates missed the key words 'microscopic examinations' in the question and gave wrong answers which referred to the nutrient content and pH of semen, or the male sex hormone level.

(ii) (1) Fair. Candidates knew the functions of the FSH and LH well. However, many candidates simply gave a straightforward description of their functions and stated that if the levels were low, there would be no formation of follicles and no ovulation. Only some candidates were aware that the levels of these hormones undergo a surge periodically and the surge is an indication of ovulation. Their levels remain low in other phases of the menstrual cycle.

(2) Good. Candidates were well aware of the fact that the oviduct is the site of fertilization and they gave this as the explanation for checking whether the oviduct is blocked or not. In fact, the blockage of oviduct, which did not allow passage of eggs or sperms, accounted for the infertility.

(iii) (1) Fair. Many candidates simply gave a straightforward description about what would happen when there was implantation and then stated that the absence of menstruation is the sign of pregnancy. They failed to think in the reverse way to explain why the absence of menstruation can be a sign of pregnancy.

(2) Well answered. Many candidates pointed out that once the degeneration of the yellow body was prevented, the yellow body would secrete oestrogen and progesterone continuously such the uterine lining would be thickened and more vascularized to provide nutrients for the development of the embryo.

(b) (i) Poorly answered. Many candidates wrongly thought that increasing cardiac output and heart rate were the two ways and scored zero mark. They missed the keywords 'regulatory' and 'control of heart beat' in the stem of the question. For candidates who were aware of the nervous control and hormonal control, they did not realize that these controls have a basal output to maintain a steady heart rate. The increase in the heart rate relies on the increase in the outputs from these two regulatory methods.

(ii) Fair. Many candidates knew that energy is required for muscle contraction during exercise. However, they failed to give a clear and logical description of the importance. They often stated that the muscles need a large amount of oxygen for respiration but failed to link it up with the increased blood supply which could provide more oxygen to the muscle. Some candidates wrongly used the concept of oxygen debt to explain the importance. They were not aware that oxygen debt referred to the condition of breathing heavily even after exercise. Therefore, the provision of more oxygen for oxidation of lactic acid was invalid.

(iii) Poorly answered. Many candidates attempted to provide the importance of thermoregulation achieved by the increased blood flow to the skin rather than the cause. Candidates who attempted to provide the mechanisms of thermoregulation during exercise often missed some important details. For example, they only stated that the body detected a high temperature and increased blood flow to the skin for heat dissipation. They ignored how nervous control is brought about and the role of hypothalamus in thermoregulation.



**Section B**

2. (a) (i) Good. Most candidates knew that carbon dioxide is a greenhouse gas. However, many candidates gave simple answers stating that carbon dioxide traps heat. They missed the details, such as the source and the form of the heat.

(ii) Poorly answered. Many candidates understood that photosynthesis absorbs carbon dioxide from the atmosphere. However, when they attempted to explain how photosynthesis would slow down the rate of increase in carbon dioxide production, they failed to refer to concepts related to factors (i.e. the concentration of carbon dioxide in this case) affecting the rate of photosynthesis.

(iii) (1) Poorly answered. Most candidates stated the change in the stomatal density. However, many of them were not aware that the dependent variable should be the stomatal density in this case and failed to provide a proper explanation. When they attempted to elaborate, many of them referred to the effect of the stomatal density on transpiration instead of the effect on the rate of gas exchange.

(2) Poorly answered. Many candidates did not refer to the water cycle in their answer. They often gave irrelevant answers such as increasing the chance of flooding or soil erosion. Some stated that the weather has become dry or humid.

(b) (i) (1) Fair. Although candidates were aware that there was a decrease in the dissolved oxygen level from Location 1 to Location 2, many of them wrongly thought that it was due to algal bloom. They were not aware that the sewage from the pig farm was mainly organic matter rather than inorganic matter.

(2) Poorly answered. Only two-fifths of the candidates correctly interpreted the data presented in the table and only some of them were able to relate the change in animal species to the oxygen-tolerance of the species. Many candidates simply focused on the number of species and ignored the fact that the type of species also changed. Among those candidates who were aware that species were completely different, some wrongly suggested that evolution had taken place, leading to the emergence of new species in Location 2. This reflected that candidates had a poor understanding of the situation.

(ii) (1) Poorly answered. Many candidates were not aware that the organic matter in the sewage could be used up and hence oxygen consumption by microorganisms was much reduced. Some candidates pointed out that oxygen from air would continue to dissolve in water. Some candidates wrongly thought that there were more trees in Location 3 and this resulted in high oxygen content in the water.

(2) Poorly answered. Although some candidates correctly pointed out that the abiotic and biotic factors in the two locations were different, rarely did they give examples such as the flow rate of water (stream versus pond), shading or fallen leaves from trees. Similar to (b)(i)(2), some candidates suggested that evolution had taken place. They did not realize that this was impossible as the time involved was too short for evolution to occur.



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## Section C

3. (a) (i) Fair. Many candidates simply stated 'compare the clear zones' but did not provide a parameter for the measurement.

(ii) Good. More than 80% of the candidate correctly chose antibiotic C and most of them pointed out that this antibiotic could kill all the four microorganisms in the investigation. However, rarely did they link this up with the chance of killing the unknown microorganism responsible for the infection. Some candidates just gave repeated descriptions of the results of the investigation. Only a small proportion of candidates used the term 'broad-spectrum antibiotics' in their answers.

(iii) (1) Very poor. Many candidates ignored the fact that the aseptic techniques required should be related to the inoculation step. As a result, they gave irrelevant answers such as using an autoclave and its principle, or the necessity for sterilization of the working environment. Candidates who attempted to give aseptic techniques related to inoculation often missed some important details in their answers. For example, some candidates pointed out that they should flame the inoculation loop but they failed to state that the loop should be allowed to glow red-hot for a few seconds. Some knew that it is necessary to flame the mouth of the culture tube but they were not aware that this should be done both before and after the inoculation step.

(2) Fair. More than half of the candidates knew that this allows the choice of an appropriate antibiotic but most of them failed to state clearly the importance of this. Some just stated that this could prevent the development of antibiotic resistance in microorganisms without elaboration.

(iv) Poorly answered. Most candidates did not generalize the properties of antibiotics as demonstrated by the results of the investigation. They usually described the results repeatedly in their answers.

(b) (i) Poorly answered. Many candidates just treated it as the plateau phase of the growth curve for microorganisms and stated that the depletion of nutrients and accumulation of metabolic waste were the two factors that led to the drop in the population of sewage microorganisms. Only a small proportion of candidates correctly pointed out that the UV light in sunlight was harmful to sewage microorganisms. Only a few candidates were aware that the nutrient content in unpolluted water was low.

(ii) Poorly answered. Only a few candidates knew that sewage microorganisms might have different tolerances for environmental stress.

(iii) Very poor. Candidates showed a poor understanding of the criteria for choosing indicating organisms for water pollution. Many candidates chose microorganisms C and gave the supporting reason that its population exhibited the slowest decline among the three microorganisms. However, they were not aware that C was naturally present in unpolluted river water from the very beginning. They thought that the populations of both A and B dropped too quickly.

(iv) Poorly answered. Only some candidates were able to give correct explanations.



## Section D

4. (a) (i) Good. Most candidates correctly stated the roles of white blood cells in human bodily defences.

(ii) Poorly answered. Many candidates gave the straightforward description that bone marrow cells were undifferentiated cells and were capable of forming white blood cells. However, they missed the details of the gene therapy, i.e. once the ADA gene was inserted, the white blood cells produced thereafter would be able to produce the required enzymes and function normally. Some also failed to explicitly state that engineered white blood cells would be lost due to limited life span.

(iii) Poorly answered. Many candidates treated this as genetic engineering of a bacterial cell and wrongly talked about insertion of the desired gene into the plasmid of bone marrow cells. They did not know that plasmids are used to transform bacterial cells only, whereas viral vectors are required to insert the DNA fragments into the human genome. As a result, many candidates gave descriptions of the use of restriction enzymes to cut the desired genes and plasmids, and the use of ligase to glue the desired genes into the plasmids. These were irrelevant to the situations in this case. They seldom mentioned the production of functional gene products in their answers.

(iv) Poorly answered. Many candidates gave vague answers about the final outcome such as causing cancer or unknown side effects, which could be applicable to many other treatments. Candidates should have referred to the process of the therapy and highlighted the stages at which these potential hazards might arise, such as insertion of the gene into sites with specific functions, or the use of a viral vector that triggers unwanted immune responses.

(b) (i) Good. Candidates usually gave a short description of the stages or the names of the stages involved in a PCR cycle. Some wrongly stated that restriction enzymes and ligase were involved during the extension stage.

(ii) (1) Good. About two-thirds of the candidates correctly identified the stage as the extension stage.

(2) Fair. Although more than 80% of the candidates correctly chose the right DNA polymerase to be used, most failed to provide a clear and logical explanation of their choice. In fact, candidates were required to integrate knowledge about PCR and the useful information from the graph. In this case, many candidates were not aware that all the substrate and enzymes were added to the PCR machine at the very beginning. They treated the three stages as three distinct processes and thought that the enzymes were added separately at each stage. As a result, they focused their discussion on DNA polymerase at the extension stage and forgot to mention that the DNA polymerase would be exposed to 90°C at the DNA denaturation stage. In contrast, some candidates did not quote useful information from the graph. They simply stated that enzymes would be denatured at high temperatures.

(iii) Good. About two-thirds of the candidates correctly stated one application of PCR.



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General comments and recommendations:

Generally, candidates did well in straightforward questions that required recall of biological knowledge. They were able to reproduce textbook materials or answers from previous exams. However, they lacked the ability to select relevant knowledge to address the requirements stated in the questions. As a result, for questions involving a scenario (e.g. Paper 1 Q.9 and 10; Paper 2 Q.1(a) and Q.4(a)) or questions involving data analysis (Pape 1Q.8; Paper 2 Q. 1(b), Q.2 and Q.3), they simply recited textbook materials on the relevant topics without adaptation, leading to a failure to address the specific requirements of the questions. Candidates are advised to study the questions carefully, especially those with a context given, and select and adapt what they have learned from textbooks to address the issues concerned so as to avoid giving too much irrelevant material. Candidates' performance in questions related to scientific investigation was unsatisfactory. In general, they were weak at relating the observable features to knowledge learned. Misinterpretation of independent and dependent variables also led to failure to provide a clear explanation of the causal relationship between the factors involved. Candidates should also pay attention to the sentence structures used in their answers, especially in dealing with questions that involve data analysis and comparison. It is worth noting that many candidates simply repeated the data given without attempting to explain the patterns or trends. Training in experimental design and analytic skills for data interpretation and deduction should be strengthened. This could be achieved by exposing candidates to a wider range of experiments, including both qualitative and quantitative ones. 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.



**School-based Assessment**

All school candidates sitting for HKDSE Biology Examination have to participate in School-based Assessment (SBA). A total of 16063 students from 441 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.

A 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. 68.7% of schools fell into the 'within the expected range' category, while 17.5% of schools had marks higher than expected, and 13.8% 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 majority of the teachers had a good understanding of the SBA requirements, and that the marking standards were appropriate, which is encouraging. 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 of 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:

The objective of the investigation is sometimes not stated clearly, such as 'Studying the osmosis of plant tissues'. Teachers may start an investigation openly to let students come up with specific investigative questions, but only with a clear objective or investigative question would students be able to design and plan the investigation in latter stages. Otherwise, they may only follow the instructions of the teacher.

Many reports showed that students are still confusing variables with their measures. In the investigation on why pineapple jelly does not set, the independent variable is not boiled or unboiled pineapple, but the presence of protease. In the investigation on the effects of ethanol on the cell membrane permeability of beetroot tissue, the dependent variable is not the degree of red colouration or amount of red pigment leaked out, which is just the measure of membrane permeability. In estimating the vitamin C content of fruit juices using DCPIP solution, the dependent variable is vitamin C content, but many students wrongly considered it to be the number of drops of DCPIP solution used for titration. To distinguish measures from variables is important in appraising the validity of conclusions since there are often inferences and assumptions between measures and variables. The amount of DCPIP solution only represents the amount of vitamin C if it is assumed that vitamin C is the only anti-oxidant in the juice that can react with DCPIP.

Some students were unable to present data appropriately. In the investigations to estimate the water potential of potato cells, a best fit line should to be drawn across the data points rather than using smooth curve or short straight lines to join up all points. Many students failed to make the data table self-explanatory, for example including solutions coded A1, A2, B1, B2 in a table without indicating what they are. Sometimes necessary calculations of the data such as averages, or the formula for the calculation, such as the percentage change in the mass of potato, were missing from tables.

Students were weak in discussing the 'errors' of experiments. First of all, 'uncertainty' may be a better term to use since not all uncertainties are the result of errors but may result from the limitations of instruments or from unknown, random factors. Students often list every possible 'error' without justifying how likely they are to affect the validity of the conclusion. For example, in investigating the effect of ethanol on the membrane permeability of beetroot tissue, a student pointed out 'errors' including the unequal amounts of ethanol in different treatments, too high an ambient temperature, which may denature the membrane proteins, the unequal distribution of red pigments in beetroot tissue and the inaccurate estimation of the red colour by the naked eye. The first two 'errors' are unlikely to be significant. The unequal distribution of pigment in tissue had been dealt with by replicating the treatments four times with randomly chosen tissue discs. The only significant 'error' is the estimation of colour, but it had been reduced to some extent by the replication and the clear differences in colouration between the treatments. Therefore, the 'errors' mentioned in the report are not likely to constitute significant threats to the



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validity of the conclusion. This kind of discussion (discussion of 'errors' in connection with the design and results) should be strengthened in the student reports.

As for the types of investigations, those which were commonly undertaken in the past few years were still prevalent this year, for instance the water potential of potato tissue and fruit jelly setting. Teachers can try more diverse investigations that are related to everyday life and call on more inquiry skills.

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 plagiarizing 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.



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