CARIBBEAN EXAMINATIONS COUNCIL

CSEC® BIOLOGY

Subject Report

May–June 2025

CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE
CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

MAY–JUNE 2025

BIOLOGY
GENERAL PROFICIENCY

Table of Contents

INTRODUCTION

This guide has been put together using candidates' responses to the May—June 2025 CSEC Biology examination.

The examination comprised the following papers.

- Paper 01 — Multiple Choice
- Paper 02 — Structured Essay
- Paper 031 — School-Based Assessment (SBA)
- Paper 032 — Alternative to School-Based Assessment (private candidates)

Candidates' performance was assessed across three profile dimensions: Knowledge and Comprehension (KC), Use of Knowledge (UK) and Experimental Skills (XS).

In Profile 1 (KC), 78.18 per cent of candidates achieved Grades A–C compared with 71.70 per cent in 2024 and 72.89 per cent in 2023. For Profile 2 (UK), 69.21 per cent of candidates obtained Grades A–C, which represented an improvement over 2024 and 2023 when the percentage of candidates who obtained Grades A–C was 59.64 and 47.47 respectively. In Profile 3 (XS), 95.84 per cent of candidates achieved Grades A–C, compared with 95.26 per cent in 2024 and 95.98 per cent in 2023.

PAPER 01 — MULTIPLE CHOICE

Paper 01 consisted of 60 multiple choice items. It was designed to provide broad coverage of the syllabus, with items drawn from all sections. The mean score was 45.38 out of 60.

PAPER 02 — STRUCTURED/EXTENDED ESSAY

Question 1

This question assessed Specific Objectives B 8.2, 8.3, 9.2 and 9.3. Candidates were required to demonstrate an understanding of the

- external and internal structures of a dicotyledonous seed
- processes that occur within a seed during germination
- structure and function of the reproductive systems in humans
- role of oestrogen and progesterone in the menstrual cycle.

Part (a)

Candidates were required to outline four activities that occur within a seed during germination. Full marks were awarded for correctly stating any four of the following activities.

- Enzymes break down stored food in the cotyledons.
- Food is translocated to the growing points, namely the radicle and plumule.
- Enzymes are activated.
- Proteins are broken down into amino acids.
- Starch is broken down into maltose and then glucose.
- Lipids are broken down into fatty acids and glycerol.
- Amino acids are used to form new cells at the tips of the radicle and plumule.
- Glucose is used to provide energy for the growth of the radicle and plumule.
- Glucose is used in the formation of cellulose for new cell walls.
- Fatty acids and glycerol are used in respiration.

Many candidates provided clear and accurate responses and were awarded full marks for this part of the question. However, some candidates listed incorrect or irrelevant activities, such as ‘storage of food in the cotyledons as the testa’ or ‘the seed coat falls off’, which did not earn marks.

Part (b)

Parts (b) (i) and (ii) required candidates to produce a large, accurately labelled diagram showing the internal structures of a dicotyledonous seed. Some candidates were able to score full marks for the labelled drawing. Marks were awarded based on the following criteria.

- Accuracy of the embryo
- Smooth and continuous lines
- An appropriate title
- Neatness
- Absence of shading

- No crossing of labelling lines.

Candidates were also required to provide annotations for the structures shown. Full marks were awarded for stating a minimum of three correct annotations. Acceptable responses included the following.

- Cotyledon — stores food for developing seedling.
- Radicle — the embryonic root/develops into first root.
- Plumule — the embryonic shoot/develops into shoot.

Part (c)

A figure showing the levels of two hormones involved in the human menstrual cycle over a two-month period was provided. Candidates were required to use the graph to answer the questions in this part. In Part (c) (i), candidates were first asked to identify and shade the periods during which menstruation was likely to occur on the graph. Most candidates correctly identified and shaded Days 1–5 and Days 28–5. Acceptable alternative ranges, such as Days 0–7 and Days 28–7, also earned marks.

For Part (c) (ii), candidates had to compare the level of oestrogen on Day 28 of the first cycle with that on Day 28 of the second cycle. Most candidates correctly stated that *the concentration of oestrogen was slightly higher during the second cycle*, earning full marks. In Part (c) (iii) candidates were also asked to suggest one reason for this difference. Many candidates correctly stated that there was *fertilization of the egg* or *during pregnancy* and earned the one mark available.

In Part (c) (iv), candidates were required to compare the level of progesterone on Day 28 of the first cycle with that on Day 28 of the second cycle. Most candidates accurately stated that *the concentration of progesterone was much higher during the second cycle,* thereby earning full marks.

A table was provided to allow candidates to compare the two menstrual cycles. For Part (c) (v), candidates were required to complete the table by outlining four valid comparisons that accounted for the difference identified previously. One mark was awarded for each correct comparison. Many candidates achieved full marks. The expected responses are shown below.

First Cycle	**Second Cycle**
Unfertilized egg.	Fertilized egg.
Corpus luteum breaks down.	Corpus luteum does not break down.
Secretion of progesterone decreases.	Secretion of progesterone increases.
Menstruation takes place.	No menstruation.

Part (d)

Candidates were provided with a table outlining three occurrences within the human reproductive system. For Parts (d) (i), (ii) and (iii), candidates were required to complete the table by stating the consequences of each occurrence. One mark was awarded for each correct consequence. Some candidates were able to score full marks for this part. The expected responses are outlined in the table below.

	Occurrence	Consequences
(i)	**Mary's corpus luteum fails to develop after fertilization of the ovum.**	• The level of progesterone will fall. • The foetus will be aborted. • The pregnancy will end.
(ii)	**Eight-year-old Ruth had to have her ovaries removed.**	• Ruth's menstrual cycles would not start. • Delay of puberty. • Ruth will not develop sexually.
(iii)	**Bryan's vas deferens are severed.**	• Bryan's sperm would not be transported to the urethra. • The sperm will remain in the testes.

Recommendations

Overall, candidates lost marks due to vague explanations and the use of incorrect terminology. To address these issues, educators are encouraged to incorporate more formative assessments that require candidates to explain concepts in their own words while receiving targeted feedback. The use of visual aids and hands-on activities, such as seed dissections and menstrual cycle charting, can further reinforce understanding of biological structures and processes. In addition, regular practice with biological drawings and labelling exercises, with emphasis on anatomical accuracy and neatness, is recommended. Candidates should be encouraged to make clear, concise comparative statements when required and to avoid repetition or ambiguity in their responses.

Question 2

This question assessed Specific Objectives B 7.8 and 2.11. Candidates were required to demonstrate an understanding of

- the social effects of the abuse of diet pill among teenagers
- reasons why teenagers may abuse diet pills
- strategies that could be used to reduce the frequent use of diet pills
- other illegal substances.

Part (a)

Candidates were presented with a scenario in which a high-school student, influenced by social media, felt pressured to become thin and consequently began abusing diet pills. In Part (a) (i), candidates were required to list three social effects of the abuse of diet pills. Most candidates earned full marks by correctly identifying three of the following.

- Inability to maintain normal relationships/loss of friendships
- Increased isolation
- Anxiety
- Difficulty sleeping
- Inability to cope with normal daily activities
- Poor performance at school

However, some candidates incorrectly described physical effects rather than social effects and were therefore not awarded marks. Common misconceptions or vague responses included the following.

- Speech problems.
- Dizziness.
- Reduced appetite, resulting in person not being able to eat.
- Violence.
- Social exclusion.
- General statements such as the following.
    - She will not feel healthy.
    - She can have internal problems.
    - It can cause side effects.
    - She can get sick.
    - She is not accustomed to taking the pills.

For Part (a) (ii), candidates were required to explain one way in which the constant use of diet pills may be harmful to the student's health. Many candidates earned full marks by clearly explaining an appropriate effect, most commonly noting that the suppression of appetite can lead to malnutrition,

which may result in deficiency diseases. Responses that simply stated 'disease' without further explanation were considered vague and did not earn the marks.

Acceptable explanations of how the constant use of diet pills may be harmful included the following.

- Suppression of appetite can lead to malnutrition.
- Malnutrition has negative effects on brain function.
- Increased metabolism cannot be sustained by poor diet.
- Poor fat or lipid absorption will rob the body of fats necessary for proper functioning.
- Dependence and addiction can result from the abuse of diet pills.
- Deficiency diseases can result from a poor diet.

Candidates also received full marks when their responses clearly indicated that the body was lacking essential nutrients (malnutrition), which could result in deficiency diseases. Naming a specific deficiency disease, such as scurvy, was accepted. Responses referring to a *lack of nutrients* or *not taking in enough nutrients* were also credited as malnutrition.

Part (b)

Candidates were required to name four illegal substances that may be abused by teenagers and young adults. Many candidates performed well on this part of the question and were awarded full marks for correctly identifying any four of the following substances.

- Cocaine
- Marijuana
- Heroin
- Crystal meth
- Amphetamines
- Steroids

Overall, many candidates demonstrated good knowledge of illegal substances; however, a significant number provided common or street names instead of the correct substance names. Candidates also incorrectly referred to the following as illegal drugs.

- Alcohol
- Cigarettes
- Tobacco
- Anxiety pills
- Sleeping pills
- Painkillers

Examples of responses that were not accepted included terms such as 'mushroom' instead of *psychedelic mushroom* and 'white powder' instead of *cocaine*, as these lacked the required specificity. Two

particularly common incorrect responses were 'narcotics' and 'tobacco', which were considered either too broad or inappropriate in this context.

Part (c)

Candidates were provided with a graph showing data collected from a study investigating the use of diet pills in a Caribbean country. They were required to interpret the graph in order to answer the questions that followed. In Part (c) (i), candidates were asked to identify the population that abused diet pills the most. Most candidates correctly interpreted the data and identified *teenagers* as the group with the highest level of diet pill abuse.

Part (c) (ii) required candidates to suggest two reasons why the identified population showed the greatest level of abuse. Most candidates earned full marks by providing accurate responses. Acceptable reasons included the following.

- Easy to obtain.
- Peer pressure to use the pills.
- Agenda or information available in the media that 'thin' is in.
- People with eating disorders.
- Misconception that smaller body weight means you are healthy.

Low self-esteem was also an acceptable response that was provided by some candidates.

For Part (c) (iii), candidates had to suggest three measures that could be implemented to reduce the frequent use of diet pills in the Caribbean. Most candidates performed well and were awarded full marks for suggesting any three appropriate measures. Acceptable responses included the following.

- Campaigns to promote more physical activity to lose weight.
- Campaigns to promote healthy eating.
- Campaigns that provide information to the public on appropriate dieting.
- Enforce a minimum age for people to purchase these pills or restrict purchases to only one prescription.
- Remove the stigma from mental health disorders or depression which may lead to poor dietary habits.
- Ensure that people who have eating disorders (bulimia or anorexia) receive the appropriate health interventions or care.
- Ensure that there are affordable healthy options available on the market.
- Provide clear instructions regarding the use of the pills.

In addition, some candidates suggested measures such as *increasing the cost of diet pills to reduce affordability* and *implementing educational programmes to raise awareness about the negative effects of drug abuse*. These responses were also credited.

Recommendations

Many candidates were able to achieve at least 50 per cent of the marks allocated to this question. To further improve performance, the following recommendations are proposed.

- Candidates should learn and use the correct biological terms for illegal substances rather than rely on common or street names.
- Candidates should be able to clearly distinguish between the social and economic effects of drug use.

Question 3

This question assessed Specific Objectives B 1.2, 1.3, 1.4 and 1.6. Candidates were required to

- identify organelles found only in plant cells and to state their functions
- describe the structure of the mitochondrion and explain how its structure relates to its function
- apply their knowledge in describing expected observations when plant and animal cells are placed in concentrated sugar solution and distilled water.

Part (a)

in Part (a) (i), candidates were required to name three organelles found only in plant cells. Many candidates correctly identified organelles such as the *chloroplast, cell wall* and *starch grains*. Some candidates also correctly included the *large permanent vacuole*. However, a few candidates incorrectly identified 'mitochondria' as organelles found exclusively in plant cells.

In Part (a) (ii) candidates had to state the function of any two of the organelles named previously. Acceptable responses included the following.

- Cell wall — prevents cell lysis and gives the cell its shape
- Permanent vacuole — stores various substances including waste products and functions in the exchange of water and minerals
- Chloroplast — the site where photosynthesis occurs
- Starch grains — energy storage

Several misconceptions were observed in this section. These included the following.

- Misidentifying the function of chlorophyll or chloroplasts by stating that they simply give leaves their green colour.
- Incorrectly attributing the regulation of cellular entry and exit to the cell wall.
- Inappropriately referencing cellular components such as glycogen granules, mitochondria, cell membrane, ribosomes and nucleus as organelles found only in plant cells.

Part (b)

Candidates were required to explain how the structure of the mitochondrion is suited to its function. Many candidates correctly linked the large surface area of the mitochondrion to its role in respiration and energy production. However, relatively few candidates referred to key structural features such as the double membrane, the folded inner membrane (cristae) or the matrix.

While most candidates associated the mitochondrion with energy production, only very few were able to clearly explain how its structure facilitates this function. The expected response was that *the*

mitochondrion is adapted for energy production through its double membrane where oxidative phosphorylation occurs.

Part (c)

In Part (c) (i), candidates were required to complete a table showing the expected observations and to provide an explanation based on the type of cell placed in different solutions. The expected responses for animal cells are shown below.

Cell Type	**Solution Type**	**Expected Observation**	**Explanation**
Animal cell	Concentrated sugar solution	The cell shrivels or shrinks.	Water moves out of the cell and enters the surrounding solution. OR Solute concentration outside of the cell is higher than inside the cell. Solutes cannot enter cell.
	Distilled water	The cell swells or becomes larger; can lyse.	Water moves into the cell, due to the absence of cell wall; cell may lyse. OR Solute concentration outside of the cell is lower than inside the cell. Solutes cannot enter cell.

Candidates were similarly required to complete a table for plant cells, in Part (c) (ii). They had to state both the expected observations and explanations. The expected responses for plant cells are shown below.

Cell Type	Solution Type	Expected Observation	Explanation
Plant cell	Concentrated sugar solution	Plasmolysis, vacuole becomes smaller; cytoplasm comes away from the cell wall.	The water inside of the cell moves out into the surrounding solution via the process of osmosis. OR Solute concentration inside of the cell is lower.
	Distilled water	Cell swells but does not rupture.	Water will enter the cells via osmosis from the surrounding solution, causing the cell to swell. The presence of the cell wall will stop the cell from rupturing or bursting.

Recommendations

Educators are encouraged to place greater emphasis on the relationship between organelle structure and function, rather than focusing solely on the identification of functions. Overall, candidates demonstrated a reasonable understanding of osmosis and the roles of specific plant organelles. However, misconceptions were evident in some responses, particularly relating to the belief that solutes move, rather than water. Marks were also lost when candidates failed to distinguish accurately between the structural differences of plant and animal cells.

Additionally, confusion was observed in the use of terminology, with some candidates incorrectly applying terms such as ‘turgid’ and ‘flaccid’ to animal cells, which is technically inaccurate since these terms apply specifically to plant cells with cell walls. This should be reinforced during classroom exercises and laboratory sessions. Stronger responses clearly related the function of cell walls and chloroplasts to their structural roles and discussed osmosis with accurate reference to water potential gradients.

Question 4

This question assessed Specific Objectives A 2.1, 5.2, 6.2 and 6.5. Candidates were required to demonstrate their ability to

- conduct simple ecological studies using appropriate collecting and sampling methods
- discuss the importance of recycling manufactured materials and the challenges associated with doing so
- explain the negative impacts of human activities on the environment
- suggest measures through which the environment may be conserved.

Part (a)

Candidates were asked to state four challenges associated with the recycling of manufactured products. Acceptable responses include the following.

- Cost — money must be spent to establish a recycling facility. In some cases, it is more costly to recycle products than to create from raw material.
- Maintenance — poor financing of landfills or provision for adequate waste management plans.
- Difficulty with sorting materials in landfill — separating materials such as plastics, paper, rubber, metal and biodegradable versus non-biodegradable substances can be challenging.
- Time consuming.
- Training or presence of suitably trained personnel.
- Management of toxic substances.

One mark was awarded for each correctly stated challenge. Candidates who identified any four challenges were awarded full marks. However, many candidates experienced difficulty accurately describing these challenges and responses were often vague or unclear. Some candidates misinterpreted the question and referred instead to issues such as maintaining landfill space or general pollution caused by garbage.

A common misconception among candidates was the belief that only biodegradable materials can be recycled. As a result, materials such as glass, metal and plastics were often incorrectly excluded from consideration.

Part (b)

Candidates were required to explain one environmental issue that may arise from the presence of bacteria responsible for breaking down biodegradable material at a landfill. Full marks were awarded for accurately identifying any one of the following concerns.

- Production of methane gas — methane gas when allowed to vent directly into the air can contribute to global warming.

- Production of a gas or bad odour which may make the residents in the area uncomfortable.

A common misconception observed among some candidates was the belief that the bacteria involved in this process were harmful. As a result, some suggested that saprophytic bacteria could leak from the landfill and cause disease outbreaks in human populations, which was incorrect in this context.

Part (c)

Part (c) (i) required candidates to suggest one technique that could be used to conduct the ecological study described. Many candidates correctly identified suitable sampling methods, including the *quadrat*, *line transect* or *belt transect*. Some misconceptions were evident. Many candidates referred to the 'capture and release method', suggesting that they may not have had the experience of using this equipment or this method. In addition, incorrect spelling of the term *quadrat* was common.

In Part (c) (ii), candidates were required to explain how the selected technique could be used to identify plant and insect species in the unused section of the landfill. Several candidates had difficulty with this question, indicating a lack of practical experience in applying sampling methods. Expected responses varied depending on the technique chosen and included the following.

- Quadrat — Take a quadrat of known size, back the intended study area and toss the quadrat over your shoulder behind you. Approach the quadrat and identify the species present in the quadrat using appropriate species charts. Repeat three to five times across the study area.
- Line transect — Stretch a tape measure or piece of string or rope directly across the study area and secure it on the ground. Identify all of the organisms directly touching the line. Record instances where no organisms were present.
- Belt transect — Stretch a tape measure across the study area and secure on the ground. Place the quadrat next to the tape at position zero. Identify all organisms inside the quadrat and record the abundance of the identified organisms. Repeat at known distances along the tape measure until length of area has been studied.

Part (d)

In Part (d) (i), candidates were required to name two techniques that could be implemented on the farm to reduce soil erosion. Many of them were able to correctly identify appropriate practices such as *terracing, contour farming* or *strip-cropping*, with each correct technique earning one mark.

Common misconceptions were evident among candidates' responses. Several candidates listed practices aimed at improving soil fertility rather than reducing soil erosion. As a result, 'crop rotation' was frequently and incorrectly stated. Additionally, some candidates identified 'slash and burn' as a method for reducing soil erosion, which was not accepted.

For Part (d) (ii), candidates were also required to explain how one named farming practice could improve soil quality on the farm. Full marks were awarded for accurate explanations, including any one of the following practices.

- The implementation of mixed farming practices — Different crops have different nutrient needs and would use different minerals from the soil. Mix farming practices would allow each crop to obtain the required nutrients.
- Crop rotations
    - — Different crops have different nutrient needs and would use different minerals from the soil.
    - — Rotation ensures that crops would acquire the required minerals and, in some cases, may result in the replenishment of depleted minerals from the soil.
    - — Different crops have different pests and by rotating crops pests may be unable to find the crop, resulting in the decreased use of pesticides (insecticides).
- The use of organic manure in preference to artificial fertilizers — Organic manure breaks down and replaces the natural nutrient composition of the soil. It improves the crumb structure, drainage and aeration of the soil and is less likely than artificial fertilizers to be linked to pollution.

Some candidates demonstrated limited understanding of the term *organic* and gave incorrect responses. Organic farming practices refer to methods that use natural, eco-friendly methods.

Recommendations

Educators may need to adopt a multimodal approach when teaching sampling techniques, incorporating visual, auditory, reading and kinaesthetic strategies. This may include the use of field trips and outdoor exercises using the required tools and techniques.

In Part (d) (ii) it was noted that while candidates demonstrated fair knowledge of organic soil enrichment practices, many failed to recognize the role of microorganisms in the breakdown of biodegradable materials such as manure, compost and mulch. Few candidates mentioned the contribution of organisms like earthworms, beetles or organisms in the breakdown of biodegradable materials. Additionally, there was a noticeable gap in responses that attempted to explain crop rotation and/or intercropping, particularly in relation to the role of nitrogen-fixing bacteria. Overall, many candidates were unable to sufficiently elaborate on how specific soil-enhancement methods function. To address these weaknesses, greater emphasis should be placed on hands-on learning experiences or visits to locations where such practices are actively employed.

Question 5

This question tested Specific Objectives C 1.1, 2.9 and 5.2.

Part (a)

In this part, candidates were required to define the terms *allele, gene, chromosome* and *DNA*. Some candidates provided correct definitions and earned one mark for each definition. The expected definitions for Parts (a) (i) to (iv) are as follows.

- Allele — a particular form of a gene
- Gene — a segment of DNA that determines a particular characteristic (or set of characteristics) or a segment of DNA that carries information to produce a specific protein
- Chromosome — DNA and associated proteins (histones) or a self-replicating genetic structure in cells that contain the cellular DNA
- DNA —the molecule that contains all genetic information

Overall, candidates performed poorly in this section, as many were unable to provide accurate definitions for these biological terms.

Part (b)

Generally, candidates performed fairly well in Part (b) (i), which required them to name the process that leads to the production of dogs with desirable coat types. The expected answer was *artificial selection*, with *selective breeding* accepted as an alternative.

For Part (b) (ii), candidates were provided with a genetic diagram and asked to show the possible offspring produced from a cross between a pure straight-coat dog and a pure silky-coat dog. Overall, performance on this question was poor. The expected response is outlined below.

Genetic diagram

Let S denote the allele for the straight coat and s the allele for silky coat.

Parental phenotype	Straight coat	Silky coat
Parental genotype	Father: SS	Mother: ss

Gametes — S S s s

Genetic cross

	s	s
S	Ss	Ss
S	Ss	Ss

Candidates who correctly completed three to four genotypes were awarded two marks. Those who provided one or two correct genotypes received one mark and no marks were awarded if all genotypes were incorrect.

Outcome — All offspring (100 per cent) would have a mixture of straight and silky coats (genotype Ss).

A total of seven marks were awarded for this question. Candidates received one mark for defining the alleles, two marks for correctly stating the parental genotypes, one mark for identifying the alleles, two marks for accurately completing the Punnett square or genetic cross and one final mark for stating the correct outcome of the cross.

Common misconceptions were observed among candidates. Many were unfamiliar with how to correctly present a genetic cross using either a Punnett square or branching lines. Additionally, some candidates attempted to use a sex-linked cross, which was not applicable to this scenario.

For Part (b) (iii), candidates were required to suggest one disadvantage of dog breeding. Overall, candidates performed well and full marks were awarded for any one of the following disadvantages.

- The process is very costly or Jamal may have to spend a lot of money taking the dogs to the vet.
- It is time consuming.
- Dogs may inherit weaknesses, diseases, behavioural problems or have a decrease in life span.
- There may be an increase in the risk for stillborn pups.

A l*ack of variation* or *a decrease in genetic diversity* were also acceptable disadvantages for which candidates were credited.

Part (c)

In this part, a situation was presented in which variations in neck length among giraffes were observed. Part (c) (i) required candidates to name the process that, over time, led to the appearance of long-necked giraffes. Some candidates correctly identified this process as natural selection and were awarded the available mark.

Part (c) (ii) asked candidates to suggest one advantage that long-necked giraffes would have over those with shorter necks. Most candidates responded correctly, stating that *long-necked giraffes are better able to feed on fruits and leaves from tall tree*s. Overall, performance on this question was good. Other acceptable advantages included the following.

- Able to see predators from afar.
- Easier to drink/reach water.
- Taller stature can be associated with dominance in herd dynamics.

Recommendations

Many candidates demonstrated limited familiarity with fundamental concepts in genetics. This may be due to the fact that Section C (Continuity and Variation) of the CSEC Biology syllabus is often taught toward the end of the school year, which may result in rushed delivery. Consequently, candidates may not be sufficiently prepared for examination questions assessing this section.

Over the years, candidates have underperformed on questions related to genetics. It is recommended that Section C be introduced earlier in the course, allowing candidates adequate time to review, practise, and consolidate the concepts and skills required.

Question 6

This question tested Specific Objectives B 3.3, 3.4 and 3.5. Parts (a) and (b) assessed candidates' knowledge of the structure of the respiratory system, the substances found in cigarettes and the negative effects of smoking, including the difficulty associated with quitting. Part (c) required candidates to apply this knowledge to explain how the characteristics of gaseous exchange surfaces allow for the efficient exchange of oxygen and carbon dioxide.

Part (a)

A diagram of the respiratory system was provided in this part and candidates were required to name the parts labelled A to F. While many responses were correct, spelling errors and confusion between structures affected overall performance. The expected labels are as follows.

- A — Trachea
- B — Rib
- C — Bronchiole
- D — Alveolus
- E — Lung
- F — Diaphragm

Most candidates correctly identified A as the *trachea* or *windpipe*, although some of them incorrectly wrote 'pharynx', 'larynx' or 'oesophagus'. B was generally correctly identified as *rib* or *ribcage*; however, a few candidates wrote 'intercostal muscles' instead.

The structures labelled C (*bronchiole*) and D (*alveolus* or *air sac*) were frequently confused. A recurring error was that of identifying C as 'bronchus'. E (*lung*) was generally identified correctly. F (*diaphragm*) was also correctly identified, although some candidates gave incorrect responses such as 'pancreas', 'liver', or 'stomach'.

Spelling inaccuracies such as 'diaphram' and 'aveoli' were common. Marks were awarded unless more than two letters were incorrect (for example, 'dieaphrame'). Candidates are encouraged to practise how to spell biological terms.

Part (b)

For Part (b) (i) candidates were required to outline one way in which two named substances in cigarettes could negatively affect Simon's health. This section was worth four marks, one mark for naming each substance and one mark for describing the associated harmful effect. Expected responses included the following.

- Cigarettes contain nicotine. This substance can
    - make cigarettes highly addictive
    - reduce airflow in and out of the lung
    - paralyze cilia lining the trachea leading to problems removing dirt and bacteria
    - raise blood pressure
    - increase the rate of osteoporosis.
- Cigarettes contain tar. This substance can
    - stick to the cells in lungs and affect lung function or damage lung tissue
    - cause the development of cancer or cancerous cells which grow abnormally and continuously and which may lead to death
    - break down alveoli thus affecting gas exchange
    - cause bronchitis or smoker's cough.
- Cigarettes contain carbon monoxide. This substance can
    - combine freely with haemoglobin and affect oxygen carrying capacity or cause less oxygen to be transported/cause breathlessness
    - causes headaches, nausea and fatigue
    - can lead to unconsciousness, coma and death.

Many candidates were familiar with the effects of cigarettes on the human body, especially the respiratory and circulatory systems, and with the impact of addiction. Candidates who performed well named a specific substance first, then correctly matched it with an appropriate effect.

Tobacco was also commonly named and candidates were awarded a mark for doing so. Less frequently mentioned but acceptable substances included heavy metals, formaldehyde and arsenic. However, terms such as 'particles', 'particulate matter', 'grabba' and 'marijuana' were not accepted.

Nicotine's most widely known effect, its addictive nature, was frequently stated. Some candidates expanded their responses by noting that nicotine triggers dopamine release, leading to pleasurable sensations. Only a few candidates identified mental health-related effects such as anxiety. A few mentioned cardiovascular effects such as narrowed blood vessels, increased blood pressure and heart rate, increased platelet stickiness and heart disease. Respiratory effects, including reduced airflow, paralysis of cilia and damage to the vocal cords were the least commonly stated effects.

The effect of tar, a black substance that sticks to the cells in the lungs, was stated by many candidates. Many were able to identify tar as the cause of lung cancer. Other suitable effects were that tar damages lungs and reduces gas exchange or diffusion and causes smoker's cough or bronchitis. Very few candidates identified tar as an irritant capable of stimulating goblet cells, resulting in excess mucus production in the trachea.

Carbon monoxide was also well understood, with many candidates correctly stating that it combines with haemoglobin and reduces the oxygen-carrying capacity of the blood.

In Part (b) (ii), candidates were required to suggest why Simon was unsuccessful in his attempt to stop smoking. Many candidates simply stated that *cigarettes contain nicotine and this is addictive* which, while correct, did not always provide the depth expected. Acceptable responses included the following.

- He did not work closely with a professional, for example, a doctor or smoking cessation coach.
- He did not receive adequate advice or information on the best way to go about quitting smoking.
- Smoking contains nicotine and this is addictive so he may not have been able to stop.

Other valid responses offered by some candidates included the following.

- Simon experienced withdrawal symptoms and resumed smoking.
- Peer pressure from friends who smoked influenced him to continue smoking.

Part (c)

This part required candidates to explain how two characteristics of the gaseous exchange surface in humans allow for the efficient exchange of oxygen and carbon dioxide. Expected characteristics and their functions are shown below.

- Very thin — allows gases to diffuse across them easily
- Large surface area — increases the rate of diffusion by allowing many molecules to diffuse across the surface at the same time
- Moist — prevents surface cells from dehydrating and dying and allows for oxygen to dissolve
- Well ventilated — has a good supply of oxygen to maintain concentration gradient for diffusion
- Close to a transport system — this allows for gases to be transported to and from cells in all parts of the body

An example of a response that earned full marks is as follows.

> The alveoli are moist, which prevents surface cells from drying out and allows gases to dissolve, aiding diffusion. The gas exchange surface is also close to a transport system, allowing gases to be transported quickly to and from all parts of the body.

A few candidates misinterpreted the question and described processes such as breathing, inhalation and exhalation or aerobic respiration, which did not satisfy the requirements and therefore earned no marks.

Recommendations

Candidates should focus on improving their ability to label and spell biological structures accurately. Many topics include key diagrams that can be memorized. In this question, Part (a) required the labelling of the respiratory system, which relied on recall and correct spelling. Carefully studying the structure of the alveolus and gaining an understanding of how its features relate to its function would have better prepared candidates for Part (c).

Additionally, candidates should revise the three main harmful components of cigarettes: nicotine, tar and carbon monoxide, and should seek to understand their specific effects on the body and its systems. When responding to such questions, it is essential to use appropriate biological terminology and to clearly describe relevant processes.

PAPER 032 — ALTERNATIVE TO SCHOOL-BASED ASSESSMENT (SBA)

Question 1

This question tested Specific Objectives A 3.2, 3.3; B2.3 and 4.13. The profiles assessed were Use of Knowledge and Experimental Skills.

Part (a)

In Part (a) (i), candidates were required to produce a large, accurately labelled drawing of the leaf specimen. This part was worth ten marks, awarded based on the following criteria.

Drawing

- Accuracy of representation
- Smooth, unbroken lines
- Appropriate title
- Neatness
- No shading
- Magnification correctly recorded with the multiplication sign

Labels

Candidates who correctly labelled apex, smooth margin, midrib, branching veins, lamina, and petiole earned the full four marks for providing five to six accurate labels.

Some candidates drew a diagram of a typical dicotyledonous leaf rather than the cabbage leaf provided. This error resulted only in the loss of the accuracy mark if all other criteria were met. Candidates who titled the specimen *lettuce leaf* were not penalized, provided the title appropriately reflected the drawing. Greater care must be taken by candidates in reading and interpreting the information which is required to answer a question fully and correctly. Additionally, many candidates demonstrated difficulty with linear magnification, which refers to how many times larger the drawing is compared with the actual specimen (in this case, the cabbage leaf).

In Part (a) (ii), candidates were expected to show how the magnification of the leaf drawing was calculated. Many responses incorrectly stated that a hand lens was used to determine magnification, while others measured both the length and width of the specimen and multiplied the two values. The correct approach is as follows.

Magnification = Size of drawing/Size of specimen

For Part (a) (iii), candidates examined the cross-section of a leaf using a hand lens and were required to produce a labelled drawing. Many responses, however, depicted highly detailed cross-sections resembling electron micrographs, including structures that would not be visible with a hand lens. Marks were awarded based on the following criteria: one mark for an appropriately shaped cross-section and two marks for accurate labels such as the midrib, vein, upper epidermis, and lower epidermis.

For Part (a) (iv), many candidates accurately drew a straight line labelled X—Y on the original leaf diagram. Many completed this accurately and received the one mark allocated for correct placement. Errors included drawing the line longitudinally from the apex to petiole, placing it across the petiole region or omitting it entirely. These issues highlight the need for more consistent practice with respect to basic practical drawing skills.

In Part (b), many candidates earned full marks for explaining the role of a leaf in a terrestrial food chain containing four organisms. Strong responses demonstrated a clear understanding of how energy flows through an ecosystem. The expected points included the following.

- Plants (Specimen A) use energy from the sun to convert carbon dioxide and water into glucose during photosynthesis. This glucose may be converted to starch and stored in the leaves.

  OR

  Specimen A may simply be identified as the primary producer.
- The energy stored in glucose or starch is transferred to the primary consumer, which feeds on the plant.
- The secondary consumer obtains some of this energy when it feeds on the primary consumer.
- The tertiary consumer then feeds on the secondary consumer and receives a further portion of the energy.

Part (b)

A diagram of a longitudinal section of an onion bulb was provided in this part. Candidates were required to outline two ways in which the swollen leaves of the onion bulb are significant to the plant. Two marks were awarded for stating any two correct functions relating to the stored sugars in the leaf bases. Acceptable responses included the following.

- Used in respiration to produce energy
- Used for growth of the plant
- Converted to cellulose used to make cell walls
- Converted to starch and stored
- Converted to amino acids and protein
- Converted to chlorophyll

Additional marks could also have been earned for any of the following valid points.

- Protection of the delicate central bud by scale leaves

- Structural support and giving it shape
- Protection from excessive water loss (from the bulb)
- Enabling survival of the plant during adverse conditions

Recommendations

- The theoretical–practical nature of Paper 032 requires candidates to engage meaningfully with the experiments presented in the various textbooks available. Regular practice with these activities will better prepare candidates for the examination.
- Many candidates demonstrated limited mastery of basic practical skills such as the following.
    - Neatness in drawing by using a sharpened pencil and erasing errors cleanly
    - Shading of drawing/diagram
    - Making sure that the diagrammatic representation is accurate
    - Proper labelling of structures without the crossing of labelling lines
    - Providing accurate and appropriate titles for drawings
    - Calculating linear magnification correctly and placing the value near the drawing or beneath the underlined title

Many of the required practical activities are available on social media. These could prove helpful and provide other opportunities for candidates to become familiar with the practical activities.

Question 2

This question tested Specific Objectives B 7.6 and 7.9, targeting the profiles Use of Knowledge and Experimental Skills. Candidates were expected to explain a simple reflex arc related to the eye and to demonstrate understanding of how the structure of the human eye relates to its function.

Part (a)

In Part (a) (i), candidates were instructed to design an experiment to investigate the response of the human eye to light. A complete procedure was expected to include the following steps.

- Dim the lights in the room.
- Place your hand or sheet of paper as a shield between the test eye and the other eye.
- Shine a penlight cautiously at an angle into the test eye and record observations or record what happens to the pupil of the eye when the light is shone into it.
- Move the light away and record what happens to the test eye.
- Repeat the experiment on the test eye.
- Repeat the experiment on the other eye.

While some candidates identified portions of the method, many of their responses lacked key details required for a complete method. In several cases, candidates did not fully understand what the test required, which resulted in incomplete or inappropriate procedures.

In Part (a) (ii), candidates were required to state three precautions that should be taken when conducting the experiment. Most candidates were able to provide appropriate responses. Expected precautions included the following.

- Ensure the light is not shone directly into the eye, as this may cause damage.
- Avoid shining the light into the eye for an extended period of time.
- Hands should be washed or properly sanitized before being used as a shield.
- Ensure a shield (hand or paper) is used to prevent the eye not being tested from directly responding to the light until it is tested.
- The light in the room should be dimmed or at least kept constant to decrease interference in the response to the penlight.
- Eyes should be allowed to rest between the periods of testing.

Part (b)

For Part (b) (i), candidates were asked to provide a suitable title for the table presented. Many responses correctly linked changes in light intensity to changes in pupil size. Examples of acceptable titles included

The effect of light intensity on pupil size and *Pupil size according to light intensity*. However, several candidates presented poorly phrased titles that did not clearly reflect the relationship shown in the data.

In Part (b) (iii), many candidates entered the average pupil sizes based on the values provided. Many of them completed this section accurately. However, many candidates left the spaces blank, suggesting that there was uncertainty about how to calculate an average. Others summed the values in each row instead of determining the mean. The completed table below illustrates the accurate and expected values.

Light Intensity (lux)	**Pupil Diameter (mm) Test 1**	**Pupil Diameter (mm) Test 2**	**Pupil Diameter (mm) Test 3**	**Average Pupil Size (mm)**
4	5.35	5.45	5.40	5.40
40	5.30	5.25	5.39	5.31
400	4.20	4.40	4.75	4.45
600	3.50	3.55	3.70	3.58

In Part (b) (iii), many candidates were able to state an appropriate conclusion based on the data provided. A commonly accepted conclusion was *as light intensity increases, pupil size decreases.* However, some candidates demonstrated limited understanding of the relationship between light intensity and pupil diameter, which prevented them from drawing accurate conclusions from the results.

Part (b) (iv) required candidates to explain, with reference to the named structures of the eye, how the loss of colour vision in dim light and the return of colour vision in bright light occurs. An expected response is as follows.

- The retina, photoreceptors called rods and cones are present.
- Rods are active in dim light but only allow you to see in black and white.
- Cones are active in bright light and allow you to see colour.

Recommendations

While overall performance on this question was satisfactory, the areas of weakness observed suggest the need for a multi-tiered approach to teaching the reflex arc and the functions of the human eye. This approach should include not only didactic classes but should also incorporate appropriate laboratory exercises and sessions where students are allowed to explore concepts on their own with appropriate instructor feedback and guidance. Educators should also incorporate basic data analysis to ensure candidates are aware of their use in the biological setting.

Question 3

For this question Specific Objectives C 3.3 and B 1.6 were assessed. Candidates were required to demonstrate the ability to

- write a suitable aim from a given experimental procedure
- describe the expected observation
- state one precaution that should be taken and to provide a suitable conclusion for the experiment
- outline the observations if the same experiment were carried out under three different temperatures and to explain the difference in these observations
- state a hypothesis for another experiment based on height groups for a class and to construct a histogram from the data provided
- identify the type of variation shown by the results and explain one factor that may have led to this type of variation.

Part (a)

Overall, candidates performed well in Part (a) (i). Most candidates accurately stated the aim: *To demonstrate the process of diffusion.* However, a common misconception some candidates were unfamiliar with potassium permanganate. A few candidates incorrectly identified it as an enzyme.

In Part (a) (ii), candidates were required to describe the expected observations for the experiment. Overall, candidates performed satisfactorily. Some candidates did not make the connection with diffusion, resulting in observations that were unrelated to the process. Expected observations included the following.

- Initially, the dye is concentrated in one area.
- The particles of potassium permanganate (KMnO4) crystals begin dissolving in water.
- Particles move away from the area where they are highly concentrated to the rest of the water.
- Particles of KMnO4 crystals spread throughout the water or are evenly distributed.
- The water in the beaker changes from colourless to pink or purple.

Candiates were required to state a suitable precaution that should be taken when conducting the experiment in Part (a) (ii). Overall, candidates performed poorly on this part. Any of the following precautions were considered acceptable.

- Avoid skin contact with potassium permanganate.
- Wear gloves.
- Do not disturb the beaker after adding the potassium permanganate crystals.
- Handle beaker carefully to avoid breaking.
- Add the crystals gently to avoid disturbing the beaker of water.
- Ensure there are no variations in temperature during the experiment (constant temperature).

For Part (a) (iv) many candidates were able to provide a suitable conclusion for the experiment. A commonly accepted response was *the change in the colour of the water indicates that diffusion occurred.*

Part (b)

When asked to outline how the observations would differ among Beakers 1, 2 and 3 in Part (b) (i), most candidates recognized the general trend. However, some responses lacked detail. The expected observations were that the process of diffusion, reflected by the uniform distribution of colour, would occur fastest in Beaker 3, followed by Beaker 2, and slowest in Beaker 1.

For Part (b) (ii), candidates were required to explain the reasons behind the differences observed in Part(b) (i). Strong responses correctly linked the rate of diffusion to temperature, noting *that the rate of diffusion increases at higher temperatures.* Candidates who clearly articulated this relationship earned full marks.

Part (c)

This part required candidates to analyse data from an experiment conducted by a Biology class. The results were presented in a table and candidates used this information to complete several related tasks. The requirement for Part (c) (i) was to state a suitable hypothesis for the investigation. Strong responses offered hypotheses that were both testable and measurable, for example, *human height shows continuous variation.*

In Part (c) (ii), candidates constructed a histogram on the grid provided, using height on the x-axis to represent the data from the table. Full marks were awarded to those who labelled both axes correctly, selected an appropriate scale and plotted the bars accurately. For Part (c) (iii), many candidates successfully identified the type of variation shown. Most candidates recognized that the results demonstrated *continuous variation*, earning full marks for this part.

The final component, Part (c) (iv), required candidates to explain one factor that could have contributed to the type of variation identified within the student population in Part (c) (iii). This part was worth two marks, one for naming a relevant factor and another for explaining how that factor leads to variation. Examples of acceptable responses include the following.

- Genes — genes affect a person's ability to grow by providing the blueprint for the growth hormones.
- Environment — factors such as nutrition or exercise can affect a person's height. For instance, a well-nourished, healthy and physically active child is likely to grow taller than a child with inadequate nutrition or limited physical activity.

Recommendations

Some candidates demonstrated limited familiarity with potassium permanganate and its use in illustrating the process of diffusion. Many candidates confused diffusion with osmosis, suggesting that the underlying concepts were not fully understood. It appears that not all candidates had adequate exposure to the potassium permanganate experiment.

While there has been noticeable improvement in candidates' ability to formulate hypotheses, some of them continue to provide aims instead. Responses beginning with phrases such as 'to find' or 'to determine' resulted in the loss of marks.

The histogram was generally well done as candidates were guided by the stem of the question. However, some candidates produced line graphs or bar charts instead, signalling uncertainty about the features of a histogram and the differences among various graphical representations. It is recommended that candidates practice more graph work.