



# CARIBBEAN EXAMINATIONS COUNCIL

## CSEC<sup>®</sup> BIOLOGY



## Subject Report

*January 2025*

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE<sup>®</sup>  
EXAMINATION**

**JANUARY 2025**

**BIOLOGY  
GENERAL PROFICIENCY**

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## INTRODUCTION

This guide was compiled using candidate responses from the January 2025 sitting of the CSEC Biology examination. The report is presented in accordance with the original design of the examination paper.

The 2025 CSEC Biology examination comprised three papers: Paper 01 — Multiple Choice, Paper 02 — Structured/Extended Essays and Paper 032 — Alternative to the School-Based Assessment.

### Distribution of Grades per Profile

- Profile 1 (KC): 45.12 per cent of candidates obtained Grades A–C in 2025 compared with 44.69 in 2024 and 44.09 per cent in 2023.
- Profile 2 (UK): 22.22 per cent of candidates obtained Grades A–C in 2025 compared with 38.13 per cent in 2024 and 48.97 per cent in 2023.
- Profile 3 (XS): 94.28 per cent of candidates obtained Grades A–C in 2025 compared with 93.45 in 2024 and 93.83 per cent in 2023.

### Mean Scores

- Paper 01: The mean score in 2025 was 33.31 out of 60. This was lower than the 2024 mean of 36.53, but higher than the 2023 mean of 30.66.
- Paper 02: The mean score in 2025 was 23.04 out of 100, representing a decline from 27.54 in 2024 and 37.35 in 2023.
- Paper 032: The mean score in 2025 was 19.30 out of 40. This was similar to 19.27 in 2024, but lower than 22.48 in 2023.

Overall, there was a decline in the 2025 performance; 41.64 per cent of candidates obtained Grades I–III compared with 60.01 per cent in 2024 and 64.19 in 2023.

## PAPER 01 — MULTIPLE CHOICE

Paper 01 consisted of 60 multiple-choice items. It was designed to provide adequate coverage of the syllabus. Questions were pulled from all sections of the syllabus to ensure a balanced representation of the content.

Some of the concepts that posed challenges for candidates included the following.

- Diffusion
- Photosynthesis
- Structure of the xylem
- White blood cells
- Kidney and osmoregulation
- Pollination
- Outcome of genetic crosses

**Question 1**

This question tested Specific Objectives B 1.1, 1.3, 2.6, 2.9, 2.10 and 2.11. The profiles assessed in this question were Knowledge and Comprehension (KC), Use of Knowledge (UK) and Experimental Skills (ES).

For Part (a), candidates’ knowledge of food tests used to determine the presence of starch and fat was assessed. Candidates had to record their responses in a table. They were given an example, shown below.

TABLE 1: FOOD TESTS FOR REDUCING SUGAR, STARCH AND FAT CARRIED OUT ON JUMO

Food Nutrient	How the Test is Performed (including all reagents and suitable apparatus)	Expected Observation if the Food Substance is Present in Jumo	Expected Observation if the Food Substance is not Present in Jumo
Reducing sugar	<ol style="list-style-type: none"> <li>Mix Jumo with water and place the mixture in a test tube.</li> <li>Add an equal volume of Benedict’s (or Fehling’s A and B) solution to the test tube.</li> <li>Mix thoroughly.</li> <li>Boil gently.</li> </ol>	The mixture turns green OR yellow OR brick red OR orange precipitate.	The mixture remains blue.

Part (a) (i) dealt with testing for starch. In answering this part, some candidates incorrectly stated that the presence/absence of starch can be tested with Benedict’s solution. These candidates may have been repeating information from the example that was given.

For Part (a) (iii), regarding what would be observed if starch is absent from the food, some candidates mentioned that the colour does not change. While it is true that the colour of the mixture remains unchanged, a more accurate response would have been that *the iodine solution retains its original colour*.

Expected Response

Test for food substance	How is the test performed? (Please include ALL reagents and suitable apparatus)	What do you expect to SEE if the food substance is present in Jumo?	What do you expect to SEE if the food substance is not present in Jumo?
(a) Starch	(i) Add a few drops of iodine solution to Jumo.	(ii) Iodine turns a blue-black colour.	(iii) Iodine retains its colour (reddish-brown colour).



For Part (c), candidates were asked to state three precautions that should be taken while conducting the food tests. Many candidates incorrectly interpreted the word *precautions* to mean the use of appropriate equipment. In addition, responses which were not specific to conducting the test were not credited as valid precautions. For example, candidates who wrote 'keep the workspace neat' were not awarded a mark for that point.

Acceptable precautions include the following.

- Mix reagents thoroughly to ensure reliability of the test.
- Wear goggles to protect the eyes.
- Exercise caution when using the chemicals.
- Be careful when handling glassware.
- Interpret the grease spot test carefully; the mark on the filter paper must be permanent.
- Do not use ethanol near a naked flame.
- Be careful that no chemical/reagent is spilled; some chemicals are irritants.
- Ensure that the *Jumo* is not expired.

Part (d) asked candidates to name two diseases that a person may develop if *Jumo* is consumed in excess over a long period of time. Popular accurate responses included *obesity, diabetes and hypo/hypertension*. Other correct answers which were not popular included *cardiovascular disease* and *coronary heart disease*.

For Part (e), a simple diagram of a villus from the digestive system was provided. Candidates were required to label it, state its function and make a comparison between the epithelial cell of the villus and a typical animal cell. Additionally, a graph depicting an enzyme-catalyzed reaction was provided for candidates to interpret.

For Part (e) (i), the label for the organ in which the villus is located is the *small intestine/ileum*. For Part (e) (ii), the function of the villus is *to absorb nutrients such as amino acids, glucose, fatty acids, vitamins, and minerals*. For Part (e) (iii), *lacteal, lymph capillary and lymphatic vessel* were valid answers for the structure labelled X in the diagram.

Part (e) (iv) required candidates to suggest one adjustment that should be made to a diet if the structure labelled X is malfunctioning. Some candidates seemed not to know the function of the lacteal and so, they gave incorrect answers. The adjustment would have been *to eat less fat/fewer fatty foods*.

Part (e) (v) followed on from Part (e) (iv), asking candidates to give a reason why the adjustment mentioned would have to be made. Some candidates reasoned somewhat correctly that fatty foods contain oils which would make them hard to digest. Though this was acceptable, it would have been a thorough response if those candidates had specifically mentioned that *because of the malfunction, the absorption of dietary lipids would be hindered or adversely affected*.

In Part (f), candidates were shown a figure of the epithelial cell of the villus in the digestive system. For Part (f) (i), candidates had to outline one way in which the epithelial cell of the villus differs from a typical animal cell. The correct answer is that *the epithelial cell is a specialized cell for absorption while the typical cell is generalized and not specialized*. The explanation that *the epithelial cell of the villus has microvilli on the end exposed to the lumen of the ileum, whereas the typical cell does not have microvilli* was also acceptable. One mark was awarded to candidates for each correct statement in the comparison.

For Part (f) (ii), candidates were given a figure and were required to name the structure which carries genetic information on the form of DNA. Most candidates provided the correct name — *the nucleus*.

For Part (g) (i), candidates were given a figure and asked to place the letter A at the point on the figure where the optimal temperature of the enzyme-catalysed reaction occurs. Candidates were awarded the mark for placing the letter A at the peak of the curve, as shown below.

Figure 3 shows the effect of temperature on the rate of an enzyme-catalysed reaction.

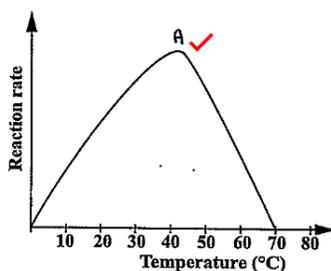


Figure 3. Effect of temperature on an enzyme-catalysed reaction

For Part (g) (ii), which required candidates to state the optimal temperature of the enzyme, many candidates provided incorrect values. The error came even from candidates who, from their previous response, appeared to understand that the optimum temperature corresponds to the peak of the curve. To ensure accuracy, a ruler should have been used to draw a perpendicular line from the peak of the curve to the x-axis.

Part (g) (iii) required candidates to explain the shape of the graph between 0 and 25 °C and between 50 and 70 °C. For the first range (0–25 °C), any two of the following points were expected.

- The rate of the reaction is increasing from 0° to 25° (No reaction at 0)
- There are more collisions between the enzyme and the substrate as the temp. increases (until the optimum point is reached.)
- The molecules are gaining kinetic energy as the temperature increases.

For the second range (50–75 °C), any two of the following points were expected.

- The rate of reaction is decreasing.
- The enzyme is becoming denatured so there are less reactions with the substrate.
- At 70°C, the enzyme is denatured, so there is no more reaction with the substrate.

## Recommendations

Teachers should make no assumptions regarding students' ability to explain tests used to distinguish among food substances including starch, protein, lipids, and both reducing and non-reducing sugars. Thorough questioning and discussion should accompany laboratory activities to ensure that students fully understand the following.

- The names and use of the correct reagents
- The treatment of the food material
- The expected results for a positive test
- The expected results for a negative test

Many candidates failed to make a sensible comparison between a typical animal cell and one that lines the ileum. This is an indication of a deficiency in their capacity to apply known facts to unfamiliar situations. Given the breadth of the syllabus, it is inconceivable that a teacher would be able to discuss the myriad exceptions encountered in the study of biology but wherever possible, students should be encouraged to examine a variety of cells so that their understanding is not limited to the generalized ones.

Students need to be instructed in the proper use of a ruler in helping to achieve accuracy when determining optimal temperature.

Extracting specific information from the graph proved to be challenging. Students need more practice in interpreting data from graphs, keeping in mind the need for accuracy.

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## Question 2

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This question tested Specific Objectives A 1.1, 1.2, 3.6, and 3.7. The profiles assessed were Knowledge and Comprehension (KC) as well as Use of Knowledge (UK).

Candidates were required to identify the type of relationship which existed between orchids that were observed growing on a large healthy tree. For Part (a) (i), candidates had to name the type of relationship that exists between the orchids and the tree.

Many candidates correctly identified the relationship as *commensalism*. However, in some cases, the misconception that the orchid lived off the tree led to the incorrect identification of the relationship as 'parasitic'. Other misconceptions resulted in incorrect responses such as 'asexual reproduction' and 'symbiotic relationship – mutualism'.

For Part (a) (ii), candidates had to outline two reasons for the answer given in Part (a) (i). Very few candidates understood that *the orchid benefits* and *the tree is not affected*. Misconceptions included the following.

- The orchid depends on the tree for nutrients/energy.
- Both the orchid and the tree benefit.
- A parasitic relationship exists — the orchid sucks the nutrients from the tree (the host).

In Part (a) (iii), candidates were asked to name two animals that are involved in the type of relationship they named in Part (a) (i). As a result, correct answers were varied. For example, candidates who suggested that the relationship in Part (a) (i) was parasitic, could have named a dog and a flea as an example of that type of relationship. Those candidates who suggested that the relationship in Part (a) (i) was commensalism, could have named a cow and an egret or a shark and a remora as correct examples of that type of relationship.

There were candidates who responded with 'bees and flowers'. This response was incorrect since the question asked candidates to name two animals.

Part (b) required candidates to say how the structural features of an organism may be used by scientists to determine its identity as either amphibian or fish. Correct responses include the following.

- Amphibians have moist, non-waterproof skin while fish have waterproof skin.
- Amphibians have no scales but fish are covered with scales.
- Amphibians have no fins while fish use fins for swimming.
- Amphibians have lungs but fish have gills.

Overall, candidates showed a lack of understanding of the term *comparisons*. Some candidates described one characteristic and then another, mentioning features that are not related in any way. Such candidates did not score any marks for this part of the question.

Unacceptable answers included the following.

- Amphibians can survive on land and in water, but fish can only survive in water.
- Both live in water.
- Both are cold-blooded.

For Part (c) (i), candidates were asked to define the term *decomposer*. Most candidates accurately defined the term, earning at least one mark. Some candidates gave vague responses such as the following.

- Decomposers get rid of parasites.
- Decomposers help to break down unwanted food in organisms.

Misconceptions included the following.

- Decomposers break down inorganic matter to organic matter.
- A decomposer is an organism which slowly breaks down a substance.

For two marks, candidates could have indicated that *a decomposer is a microorganism that feeds saprophytically on dead and waste organic matter, causing it to decompose*.

Part (c) (ii) required candidates to state two functions of decomposers. Most candidates accurately gave the two functions. However, there were also some vague responses which included the following.

- To get rid of excess waste
- To make manure and natural fertilizer
- To prevent harm to the environment by feeding on fuel

A misconception observed was that 'decomposers keep parasites at a controlled rate'.

Accurate functions of decomposers include that *they break down dead leaves and/or tree trunks, they are food for other organisms in the forest and they recycle nutrients back into the soil*.

For Part (c) (iii), candidates had to outline one way that fungi can be both beneficial and destructive to a homeowner or a builder of wooden homes. Most candidates were able to identify a destructive way. Benefits were more difficult to pinpoint.

Misconceptions regarding how fungi can be beneficial included the following.

- Fungi help prevent termites and insects from destroying the wood.
- Fungi keep pests away.
- Fungi can protect the wood from the weather.
- Builders can use the good fungi to get rid of the bad ones.

### Expected Response

Beneficial: Feed on and destroy fallen tree trunks that need to be discarded

OR

Feed on dead leaves

Destructive: Feed on wooden structures (steps, posts, fence), causing decay in garages, outdoor storerooms, and even in wooden toys such as slides, see-saw, etc.

### **Recommendations**

The differences between symbiotic relationships among organisms, such as commensalism, parasitism and mutualism, should be reinforced. Many candidates had trouble delineating each relationship.

Teachers should ensure that students get more practice in using their knowledge or applying facts they have learnt. For example, though familiar with the role of fungi as decomposers, candidates found it difficult in Part (c) to apply that information to outline how fungi can be both beneficial and destructive to a homeowner or builder of wooden homes.

The making of comparisons should be reinforced. Oftentimes, candidates compared features that are unrelated, or they used absence as a point of comparison. This resulted in the loss of valuable marks.

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### Question 3

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This question tested Specific Objectives B2.3, B2.4, B2.2, 4.2 B4.13. The profiles assessed were Knowledge and Comprehension (KC), and Use of Knowledge (UK).

For Part (a), candidates had to write the balanced chemical equation for photosynthesis and include the conditions. The balanced chemical equation for photosynthesis is shown below.



The conditions are chlorophyll and light.

In Part (b), candidates were asked to state four ways in which a leaf is adapted for the process of photosynthesis. Candidates could have written any four of the following and gained one mark for each.

- The leaf is broad and flat.
- It is at 90° to sunlight.
- It is spaced around the stem
- It is thin.
- The leaf possesses stomata.
- Air spaces exist between the cells in the lower section/part/half of the leaf.

OR

The leaf possesses a spongy layer.

- There is the presence of the waxy cuticle.
- The palisade cell layer is at the top of leaf.
- The leaf's palisade cells have many chloroplasts.
- The leaf possesses chloroplasts.
- The leaf possesses xylem.
- The leaf possesses phloem.

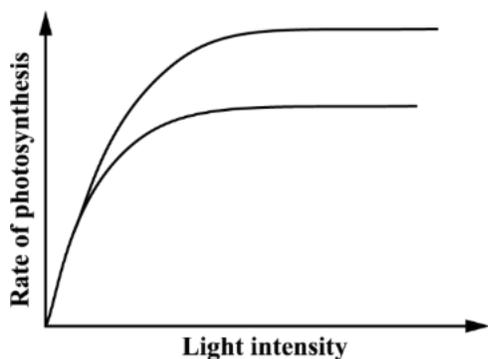
Part (c) (i) required candidates to explain the shape of the graph in Figure 4.

#### Explanation

Initially as light increases, the rate of photosynthesis increases. The light splits the water molecules faster thereby increasing the rate of photosynthesis (light dependent reaction) until a plateau is reached. The plateau is reached because of limiting factors. Limiting factors impede the rate of photosynthesis. (Limiting factors may include light intensity, water or carbon dioxide).

For Part (c) (ii), candidates had to draw a new curve on Figure 4 to indicate the expected change in the rate of photosynthesis if carbon dioxide is pumped into the greenhouse. Candidates were given one mark for the correct shape of the curve and a second mark for pitching the new curve above the original curve.

### The Expected Curve



Part (c) (iii) was based on a scenario where a farmer observes that the shaded plants in his greenhouse are taller and have smaller leaves than the plants located in sunny locations. Considering that plants do not photosynthesize when left in a completely dark environment, candidates had to explain why the plants left in the shade did not die immediately.

### Expected Explanation

- For a brief period, plants would be capable of using food stored to grow.  
OR
- Plants will utilize stored energy to grow and lengthen.
- Using stored food or energy provides the opportunity for small leaves to reach sunlight or obtain light to start the process of photosynthesis.

### **Recommendations**

Some candidates continue to have trouble distinguishing between a chemical equation and a word equation. The difference must be clearly outlined during class and/or laboratory sessions.

The process of etiolation and its relevance to plants in low-light conditions must be reviewed since many candidates displayed great difficulty regarding this. Some candidates were unable to identify the process.

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## Question 4

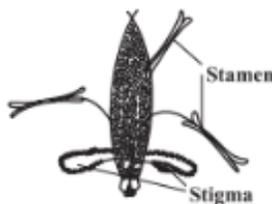
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This question tested Specific Objectives B9.1, 9.7, 9.8, 9.11, C2.3, C3.1. The profiles assessed were Knowledge and Comprehension (KC), and Use of Knowledge (UK).

For Part (a), candidates were given figures (as shown below) presenting flowers obtained from two different species of plants.



Plant A  
Figure 5



Plant B  
Figure 6

Candidates had to complete a table to compare the structures associated with the flowers of plants A and B. The expected response is shown in the following table.

Structure	Plant A	Plant B
Stigma	Sticky and found inside of the flower	Large, branched and feathery
Stamen	Short, with anthers inside of the flower	Possess long filaments, with anthers outside of the flower
Pollen Grain	Long, sticky/has spikes OR Small quantities produced	Small, smooth and light OR Large quantities produced

Part (b) asked candidates to indicate the most likely agent of pollination for each flower. Candidates were expected to state that *for Plant A, the agent of pollination is an insect* and *for Plant B, the agent of pollination is the wind*.

For Part (c) (i), candidates had to use a diagram (shown below) to identify the method by which the seeds of coconuts are dispersed.

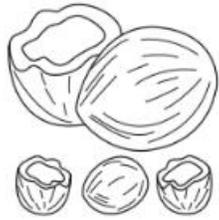


Figure 7. Diagram of coconuts

Expected Response: *The method of dispersal is water.*

Part (c) (ii) asked candidates to suggest two ways in which the seeds of coconut are adapted for the method of dispersal that was identified in Part (c) (i). The two adaptations are *epicarp waterproof* and *mesocarp fibrous and light*.

Part (d) required candidates to explain how the two types of reproduction (asexual and sexual) can impact the genetic composition of the offspring. Candidates had to state that *in asexual reproduction, offspring are produced by a single parent, and the offspring are genetically identical to the parent; whereas, for sexual reproduction, the genetic information of two organisms of different sexes are combined and offspring possess genes from both parents and not a single parent. As a result, the offspring are genetically different from the parents.*

## Recommendations

In preparation for the examination, when reviewing dispersal mechanisms, a range of plants should be used as examples. Many candidates had difficulty identifying the dispersal mechanism for coconuts even when shown an image as a stimulus. The incorporation of named examples and images may also help to alleviate this problem in the future.

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## Question 5

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This question assessed Specific Objectives B2.11, B4.6, B10.1, B10.5, and C6.1. The profiles evaluated were Knowledge and Comprehension (KC), and Use of Knowledge (UK).

Candidates performed poorly in Part (a) where they were asked to define the term *genetic engineering*. A few candidates alluded to the scientific modification of organisms and were awarded one out of the two marks. Any one of the following definitions would have been worth the two marks.

- The process in which the traits of one organism can be changed by inserting genetic material from another organism
- The process of changing the genetic structure of living cells in a laboratory
- The process of altering or manipulating genes by transferring genes from one organism to another organism

Part (b) (i) asked candidates to name the medical condition which is managed with insulin therapy. Candidates did fairly well. The correct answer was *diabetes (mellitus)*.

For Part (b) (ii), candidates were given one broad category of diseases — a pathogenic disease. They were then asked to list the three other broad categories. Overall, candidates did poorly. The other three categories are *physiological, deficiency and hereditary*.

Part (b) (iii) asked candidate to state in which of the four broad categories of diseases would diabetes, the medical condition given in Part (b) (i), be an example. Candidates, again, did poorly. The answer is *physiological*.

In Part (b) (iv), candidates were asked to explain how insulin therapy is used to manage persons with diabetes. Candidates also did poorly on this part. Marks were awarded to candidates who demonstrated an understanding that insulin is administered as an injection and is used to reduce blood sugar levels.

1. Insulin causes the removal of glucose from the blood stream in patients with hyperglycemia (high glucose).  
OR  
Insulin lowers blood glucose levels.
2. The glucose goes into the cells.
3. The liver and muscle cells convert glucose into glycogen for storage.

Part (c) was based on a scenario where Patrice contracted the measles virus, a pathogenic disease. Candidates were asked to name the process which would prevent Patrice from catching the measles virus again. Candidates also had to explain how the process works.

Naming the process was worth one mark while the other five marks were for giving the explanation. Overall, candidates performed poorly in this section. A common misconception was the belief that vaccines or medication could prevent reinfection.

#### Expected Response

- **Process:** Natural immunity/actively acquired natural immunity
  
- **Explanation**
  - Patrice was exposed to the measles virus (the antigen).
  - This caused lymphocytes to make specific antibodies against the antigen.
  - The antibodies disappear gradually but leave behind memory lymphocytes.
  - If the virus invades the body a second time, the memory lymphocytes recognize it.
  - Large amounts of antibodies are made quickly.
  - Antibodies then destroy the antigen.
  - Patrice is now immune to the measles virus.

### **Recommendations**

Many candidates were not familiar with the concept of genetic engineering. Emphasis needs to be placed on this.

Additionally, the section of the syllabus covering disease appears to have been poorly grasped. The examining committee once again recommends that the latter part of Section B of the CSEC Biology syllabus (Reproduction and Disease) as well as Section C (Continuity and Variation) be given equal emphasis as Section A (Living Organisms in the Environment) and the earlier part of Section B (Life Processes). The poor performance in these sections suggests that teachers may have rushed these topics towards the end of the school year. This does not allow students to be adequately prepared for the examination.

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## Question 6

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This question tested Specific Objectives B7.9, B7.10 and C2.10. The profiles assessed were Knowledge and Comprehension (KC), and Use of Knowledge (UK).

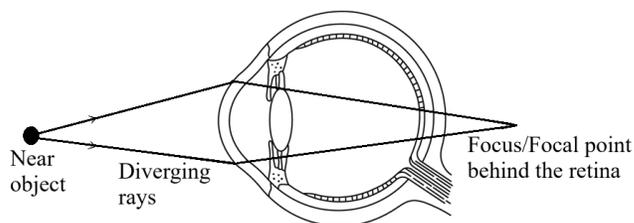
Part (a) dealt with the definition of the term *long-sighted*. Most candidates were able to state that *long-sighted is when a person can see distant objects clearly; he/she is not able to focus as well on near objects*. No mark was awarded for simply stating that 'long-sighted is when a person can see far', since this is essentially accommodation — a feature of the eye — and not a defect. For a complete definition, candidates needed to include near objects as well as the far objects.

For Part (b), candidates were shown two figures — one with vision before corrective lenses and the other with vision after the corrective lens. In Part (b) (i), candidates were asked to draw appropriate lines on the first figure to show what the vision was like before receiving the corrective lens. Most candidates drew the incoming rays incorrectly, portraying them as converging rays or parallel rays. This suggested that there was little understanding of the light of the rays from a near object which should be shown as diverging rays.

The lines to be drawn on the second figure were to show what occurs after the use of corrective lens. Candidates were also asked to draw the corrective lens. A few candidates drew the focal point on the blind spot, demonstrating that they do not understand the function of the eye.

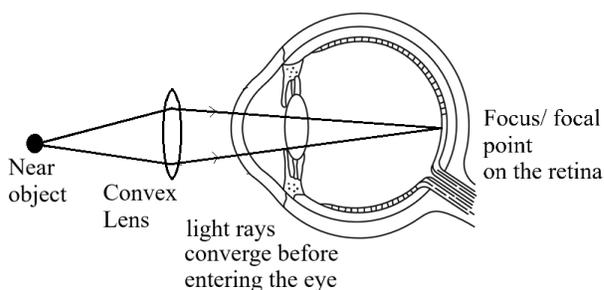
Overall, Part (b) (i) was poorly done. The visions should have been represented as follows.

### Vision Before



One mark was awarded for correctly showing the rays entering the eyes and another mark was given for showing the light focusing past the retina.

### Vision After



One mark was awarded for drawing the correct shape of the corrective lens; another mark was given for showing the light rays bending inwards and a third mark was awarded for showing the light rays now made to focus on the retina.

Part (b) (ii) asked candidates to explain how the use of the corrective lens drawn in Part (b) (i) amends Jacob's long-sightedness. Candidates also had to state the type of lens that was used.

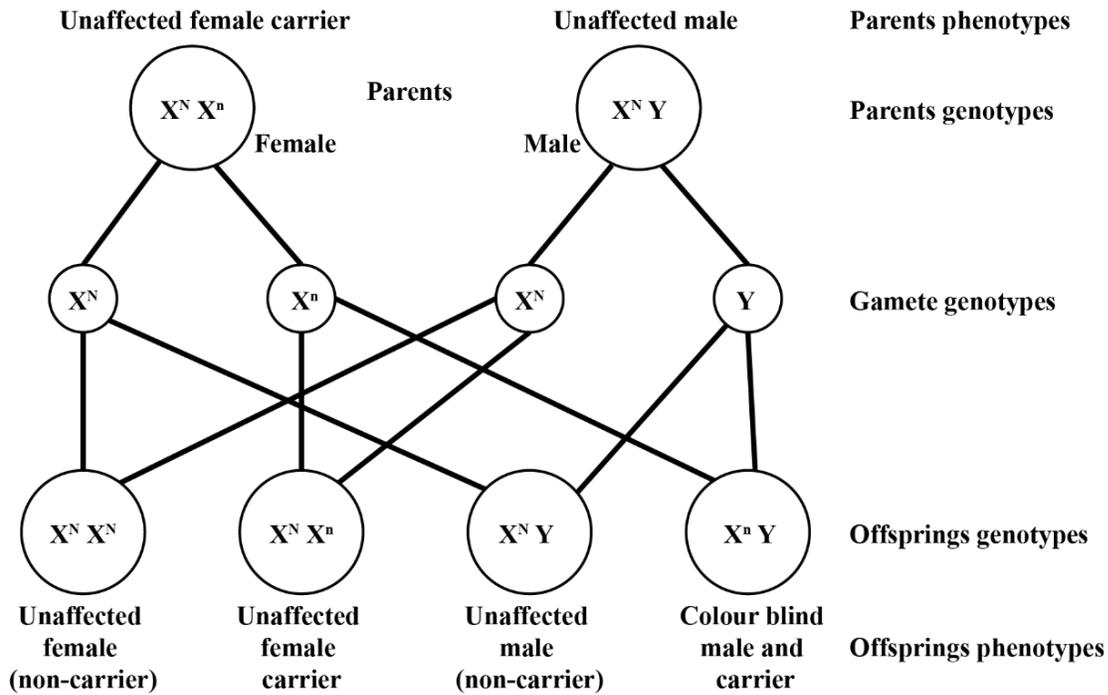
Only a few candidates were able to correctly state the type of lens as *convex lens* or *converging lens*. Incorrect answers included 'concave lens', 'contact lens', 'corrective lens', or 'glasses'. Candidates also had difficulty explaining that *the convex lens would converge (refract inwards) incoming light rays before they enter the eye, so the focal point would now fall on the retina instead of behind it*. Some candidates simply mentioned that 'the lens would refract light rays' instead of saying that it would *bend the light rays inward*.

No marks were awarded for vague responses such as saying that the lens 'helps him see better/clearer', 'reflects light', 'brings light into the pupil', or 'causes the eye to relax and prevent eye strain and headaches'.

Part (c) (i) required candidates to draw a genetic diagram that shows the cross between a wife (who is a carrier for colour blindness) and her husband (who is not affected by the sex-linked disease). This part of the question was done poorly; some candidates did not attempt it. Those who attempted the question had difficulty understanding the first step in defining the allele, that is, assigning one letter only (where the uppercase letter *N* represents the dominant normal condition and the lowercase letter *n* represents the recessive, colour-blind condition). As a result, there were incorrect pairings of letters such as 'A and B', 'A and b', or 'J and W'. Poorly chosen letters included 'C/c', 'S/s', 'L/l', and 'V/v', as their uppercase and lowercase forms appear too similar in size.

Being a sex-linked disease, candidates had trouble placing the superscript allele on the X chromosome in the genotypes. Some showed inheritance of sex chromosomes without including the allele or condition, while others placed an allele on both the X and Y chromosomes. The correct genotypes expected were  $X^N X^n$  for the carrier wife and  $X^N Y$  for the husband, who is not affected.

Expected Genetic Diagram



**N** is the normal colour vision allele      **n** is the faulty recessive colour vision allele

For Part (c) (ii), candidates had to state the probability of the couple having a boy who is colour-blind. The interpretation of this part of the question was poor as most candidates stated the answer as 50 per cent. It is possible that they counted only the male offspring. However, all four possible offspring must be considered, since the question asked with reference to the cross from Part (c) (i). Candidates must remember the Punnett square or cross shows all the possible genotypes each time the parents have a child. Therefore, the probability of having a colour-blind boy is 25%, or 0.25, or *one in four*.

## Recommendations

There are two types of diagrams in biology.

1. Biological diagrams — these show structures and how they work.
2. Genetic diagrams — these consist of a series of steps used to illustrate the inheritance of genes.

Based on this question, the following are recommended.

- Teachers are reminded that the practice of biological diagrams and drawings is a necessity for Biology students.
- In the case of eye-defects, it is recommended that students practise drawing two separate diagrams, one for each eye defect, and a separate diagram showing vision after correction with the correct lens. Practice drawings should also include rays showing vision before correction. Additionally, an understanding of the types of light rays is required.
- Candidates must understand the types of light rays from near objects versus far objects, as well as the types of lenses, and how light passes through and exits them.
- The difference between accommodation, a feature of the eye and the eye defects should be explored.
- Genetic diagrams show inheritance and thus include a series of steps that must be learnt.
- Students must understand that phenotypes are descriptions in words, and genotypes are pairs of letters. Additionally, they should note that sex-linked inheritance involves the X and Y chromosomes, so the genotypes will have superscript letters on the X chromosome only.
- Lastly, matching alleles in gametes in a Punnett square should be practised.

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## Question 1

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This question tested Specific Objectives B6.1, 7.2, 7.4 and B8.2.

Part (a) dealt with the external features of a bean which was soaked overnight. For the drawing, candidates were awarded one mark each for accuracy, smooth (versus sketchy) lines, appropriate title, neatness and no shading. Marks were also awarded for annotated labels (testa, micropyle and hilum) and for magnification. Expected annotations were as follows.

- Testa (tough, protective outer coat)
- Micropyle (tiny hole in testa; allows water into the seed)
- Hilum (scar where the seed was attached to the pod by a stalk)

The curved shape of the bean was accurately represented by many candidates. However, most candidates could not distinguish the hilum from the micropyle. Also, most candidates knew the terms *testa* and *seed coat* but displayed weak drawing skills.

Part (b) dealt with the internal features of a bean. Annotated labels for this drawing were the cotyledon, radicle and plumule and a mark was also awarded for magnification. Not many candidates labelled the required structures correctly and only a few accurate annotations were included. The magnification was poorly done — inaccurate measuring and inclusion of units — which displayed a lack of understanding of how magnification is calculated and presented. Expected annotations for Part (b) were as follows.

- Cotyledon (stores food)
- Radicle (the embryonic root)
- Plumule (the embryonic shoot)

For Part (c), candidates had to state why the response to light is important for the survival of green plants such as legumes and invertebrates such as earthworms. Most candidates were able to state why. Generally, candidates appeared to be familiar with the response of organisms to light. However, they needed to be mindful of the importance of correct spelling in Biology.

## Recommendations

Students need to be taught how to annotate drawings, which involves adding additional information next to the label. Additionally, teachers and students are reminded that all drawings and diagrams must have a self-explanatory title that clearly states what the illustration shows.

Students must be taught how to calculate the magnification of their drawings, noting that magnification has no units. Magnification = Size of drawing ÷ Size of specimen.

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## Question 2

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This question tested Specific Objectives B. 7.11 and C3.3. The two profile skill areas assessed in this question were Knowledge and Comprehension (KC), and Use of Knowledge (UK). The question was based on a given investigation regarding the levels of skin pigmentation in a population.

For Part (a), candidates had to write a suitable aim. Accepted aims include the following.

- To determine the skin pigmentation level with the highest frequency in a population
- To identify the skin pigmentation levels or frequencies found in a population

Part (b) required candidates to plot a histogram of information given in a table. Candidates were awarded marks as follows.

- Title — 1 mark
- Correct labelling of both axes — 1 mark
- Using a histogram — 1 mark
- Appropriate scale — 1 mark
- Accurate plotting — 3 marks
  - 1 bar correct: 1 mark
  - 2–3 bars correct: 2 marks
  - 4–5 bars correct: 3 marks

For Part (c), candidates had to state one precaution which should be taken when determining a person's pigmentation index. Acceptable precautions include the following.

- Accuracy of measurement/recording the correct number
- No vision impairments

Part (d) required candidates to write a suitable conclusion. An acceptable aim was that *skin pigmentation level 30 was in the highest frequency*.

Part (e) asked candidates to explain two dangers of using chemicals to alter skin pigmentation levels. The response had to include naming the process. The name of the process is *skin bleaching* and the dangers include the following.

- Skin bleaching reduces the production of melanin/inhibits the action of the enzyme responsible for the formation of melanin; therefore, the skin cannot block out all of the UV rays.
- Skin bleaching can cause a reduction in melanin leading to skin irritation, blue-black skin discolouration and scarring, thus leading to the development of cancer.
- Some skin bleaching products can thin the skin, thus increasing the risk of infection.

For Part (f) (i), candidates were to use the graph presented to determine the percentage of tongue rollers and non-tongue rollers in a class.

- Percentage of tongue rollers = 83%
- Percentage of non-tongue rollers = 17%

Part (f) (ii) asked candidates to suggest a suitable conclusion for the experiment. An acceptable conclusion was that *the class had more tongue rollers than non-tongue rollers*.

In Part (f) (iii), candidates had to name one characteristic which shows the same type of variation as tongue rolling and one characteristic that shows the other type of variation. Expected responses were as follows.

- Discontinuous – earlobe
- Continuous – height

## Recommendations

Candidates are reminded of the differences between histograms, bar charts and line graphs. They are also reminded to use appropriate scales and axis labels.

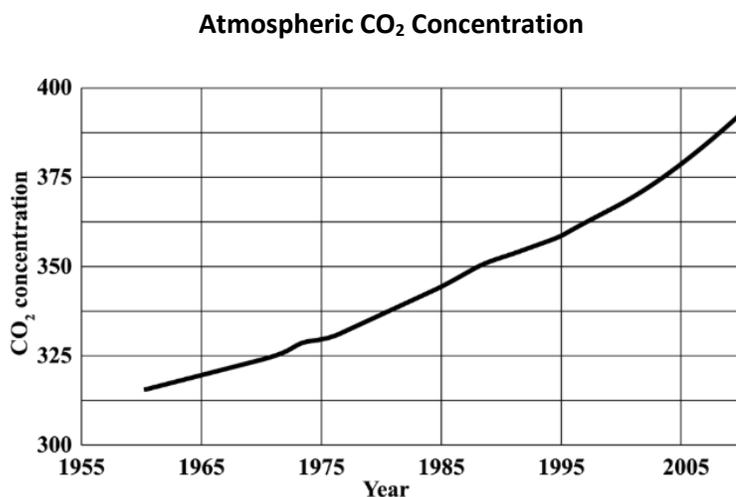
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### Question 3

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This question tested Specific Objectives A. 6.2, 6.4 and B2.2.

For Part (a), candidates had to plot a line graph of given data. The following graph was expected.



Candidates received marks for producing the requested type of graph (line), correctly labelling both axes, giving the graph a title, using an appropriate scale and plotting the graph. Many candidates lost marks because the axes were not labelled, or a title was not provided.

Part (b) required candidates to outline the main trend of the graph that was drawn. The trend was that *the atmospheric carbon dioxide concentration increased from 1955 to 2005.*

For Part (c), candidates had to explain, using one example, how the trend outlined in Part (b) may negatively impact the environment. The expected explanation is found below.

#### Explanation

Carbon dioxide is a greenhouse gas. Higher concentrations of greenhouse gases trap more heat in the biosphere and result in global warming. In turn, this drives climate change.

This increase in global warming (and higher temperatures) may

- melt polar ice sheets and glaciers and this will lead to a rise in sea level (which could threaten low lying coastal areas)
- OR
- cause droughts and this would lead to food shortages due to crops not being able to survive in harsh weather conditions.
- OR
- cause an increase in pests and diseases and this would lead to a destruction of crops

- encourage pathogens which would lead to an increase in the spread of infectious diseases
- cause extreme weather events such as changing rainfall patterns and hurricanes. This would lead to people being injured, as some cities/countries are not equipped to withstand such weather events.

In Part (d) (i), the procedure of a biology experiment was summarized and candidates had to suggest a suitable aim for the experiment. Acceptable aims include the following.

- To determine if carbon dioxide is needed for photosynthesis
- To determine the effect of potassium hydroxide on photosynthesis
- To investigate the necessity of light for photosynthesis and the presence of starch as a product of photosynthesis

For Part (d) (ii), candidates were given materials from the experiment and asked to state the role each played in the experiment. The expected response is as follows.

#### Role of Materials

Alcohol: Removes chlorophyll from the leaves

Potassium hydroxide: Removes/absorbs carbon dioxide from the jar

Iodine solution: Tests for starch

Part (d) (iii) asked candidates to state the expected colour change that would be observed in the leaf when it is tested for iodine. Some candidates stated that a 'brown' colour would be observed. Other candidates stated that the colour would be 'blue-black'.

#### Expected Answer

- The leaf, when tested with iodine solution, did not turn blue-black.
- OR
- The leaf, when tested with iodine solution, became reddish-brown.

Part (d) (iv) asked candidates to provide a suitable conclusion for the experiment. The conclusion could have been any one of the following.

- The leaf did not photosynthesize, as it did not receive any carbon dioxide.
- There was no starch present, so the test was negative.

## Recommendations

Many candidates did not achieve maximum marks for plotting the graph because they did not choose an accurate scale or did not label the axes. Emphasis needs to be placed on these areas.

During laboratory exercises, teachers need to ensure that students focus on the role of the materials used in an experiment. Many candidates could not accurately state the role of alcohol, potassium hydroxide, and iodine.

It is recommended that focus be placed on writing appropriate aims, hypotheses and conclusions for biology experiments. There were challenges with these areas.