CARIBBEAN EXAMINATIONS COUNCIL

CSEC® BIOLOGY

Subject Report with Exemplars

May/June 2024

CARIBBEAN EXAMINATIONS COUNCIL

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

MAY/JUNE 2024

BIOLOGY
GENERAL PROFICIENCY

Table of Contents

INTRODUCTION

This guide has been compiled using candidates' responses to the 2024 May/June examination in CSEC Biology. The 2024 examination consisted of the following papers.

- Paper 01 — Multiple Choice
- Paper 02 — Structured/Extended Essays
- Paper 032 — Alternative to the School-Based Assessment

Overall, 75.99 per cent of candidates obtained Grades I–III, compared with 73.69 per cent in 2023 and 78.14 per cent in 2022.

In 2024, the mean score for Paper 01 was 43.22, compared with 40.69 in 2023 and 42.10 in 2022. With reference to Paper 02, the mean score was 39.34, compared with 41.28 in 2023 and 46.08 in 2022. The mean score on Paper 03 was 32.27, compared with 31.59 in 2023 and 31.39 in 2022.

PAPER 01 — MULTIPLE CHOICE

Paper 01 consisted of 60 multiple-choice items. Some of the topics that were problematic for candidates included the following.

- Diffusion
- Effects of smoking
- Functions of the brain
- Glaucoma
- Menstrual cycle
- Asexual reproduction

PAPER 02 — STRUCTURED/EXTENDED ESSAY

Question 1

This question tested the following specific objectives from Section B (Life Processes and Disease) of the syllabus: 1.4, 1.5, 1.6, 1.7, 4.4 and 4.7. The profile skills assessed were Knowledge and Comprehension (KC), Use of Knowledge (UK) and Experimental Skills (XS).

Candidates were required to

- explain the importance of cell specialization (for example, in xylem)
- explain how the structure of xylem vessels is suited for their function
- explain the processes of diffusion and osmosis
- discuss the importance of diffusion and osmosis in living systems
- relate the structure of the components of blood to their function.

Candidate's Response to Part (a)

An experiment was set up as shown in Figure 1.

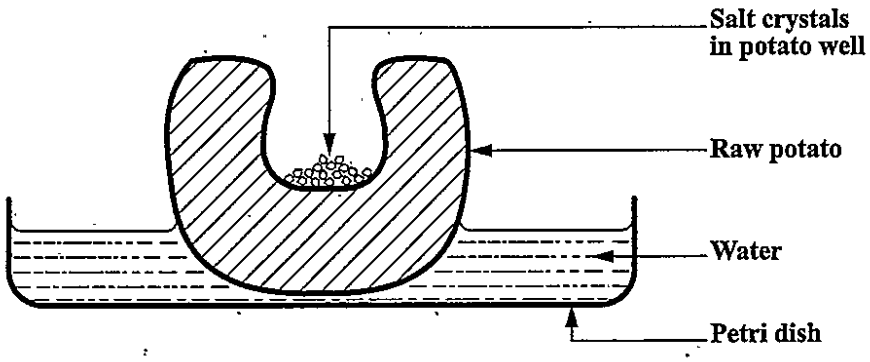
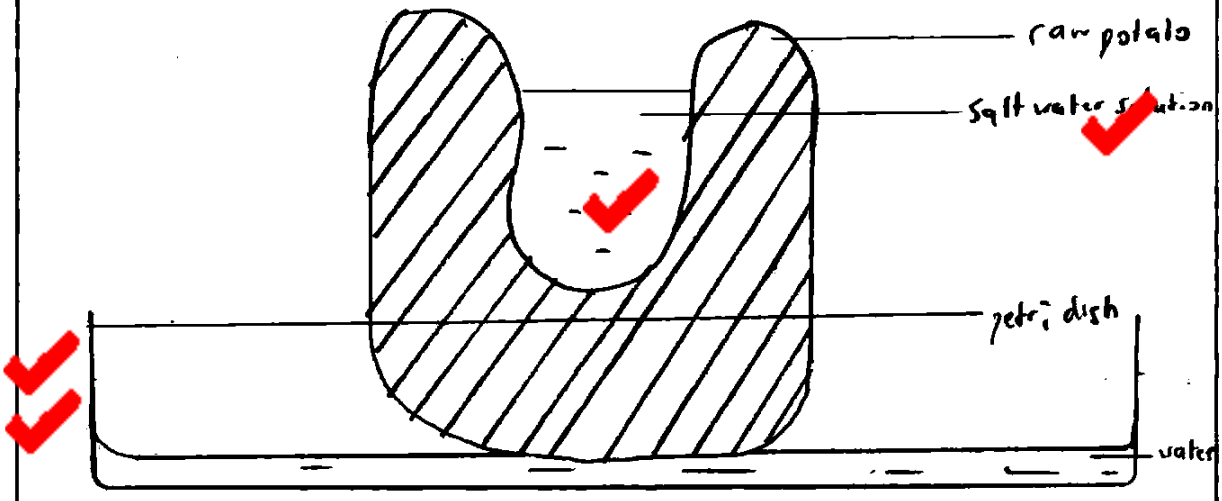


Figure 1. Experiment

Source: https://ib.bioninja.com.au/standard-level/topic-1-cell-biology/12-ultrastructure-of-cells/cell-micrographs.html

(a) Draw a large, clearly labelled diagram in the box provided **on page 5** to show what would be observed from this experiment after two hours.



DRAWING OF THE RAW POTATO AFTER OSMOSIS occurs MAG: $1\frac{3}{4}$X

(4 marks)

Examiner's Comments

The candidate drew the diagram accurately. The lines of the diagram were clean and continuous, and the liquid in the potato well was clearly shown and labelled.

General Comments

Some candidates lost marks in this section because the lines on the diagram they drew were not clean and continuous lines. Such candidates drew sketchy and broken lines.

Many candidates found it difficult to conceptualize the results of osmosis using the entire potato. There were many references to potato strips even though the diagram of the experiment clearly showed an entire potato with a well containing salt.

Candidate's Response to Part (b) (i)

(b) (i) Suggest a suitable title for the experiment in Figure 1.

Testing osmosis through the use of raw potato and salt

(1 mark)

Examiner's Comments

The candidate provided a suitable title for the experiment. The answer could have been improved if the candidate used the word investigating instead of the word testing.

Candidate's Response to Part (b) (ii)

(ii) Suggest a suitable hypothesis for the experiment in Figure 1.

Water would move from an area of higher concentration in the raw potato to an area of lower concentration in the salt. Then from an area of higher concentration in the petri dish into the area of lower concentration in the raw potato.

(2 marks)

Examiner's Comments

The candidate's statement was acceptable because it was testable and measurable.

General Comments

Providing practice for students in writing and testing hypotheses may prove to be helpful in assisting them with writing hypotheses correctly.

Candidate's Response to Part (c)

(c) The raw potato in the experiment in Figure 1 is replaced by a boiled potato. However, the remainder of the procedure is unchanged.

Suggest TWO ways in which the observations may differ when the boiled potato is used.

1. The level of the water in the petri dish would remain unchanged.

2. Salty water remains.

Examiner's Comments

The candidate was awarded full marks for providing two correct differences.

General Comments

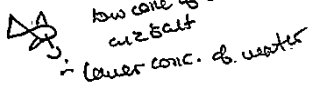
Some candidates did not understand that boiling the potato would kill the cells needed for osmosis to occur.

Candidate's Response to Part (d)

(d) Table 1 lists some observations regarding diffusion and osmosis. Complete Table 1 by stating whether EACH observation occurs by diffusion or osmosis and giving a reason for your choice.

TABLE 1: DIFFUSION AND OSMOSIS

Osmosis involves water through a membrane

Observation	Process	Reason
Amino acids (from digested food) pass across the wall of the small intestine.	Diffusion ✓	The amino acids move from an area of higher concentration in the digested food to one of lower concentration across the wall of the small intestine ✓ Also is not water ∴ Diffusion
Garden slugs shrivel when salt is sprinkled on them.	Osmosis ✓	Slugs bodies are nearly entirely made up of water ∴ A higher concentration than the salt ∴ This water moves through the differentially permeable membrane of its skin to the area of lower concentration of the salt. ✓
Saltwater fish die when they are placed into freshwater aquaria. Saltwater fish  low conc. of water ∴ lower conc. of water	Osmosis ✓	water ✗ moving through a differentially permeable membrane from an area of higher concentration to one of lower concentration
Oxygen moves from the alveoli to the blood.	Diffusion ✓	oxygen is moving from an area of higher concentration to one of lower ✓ ∴ oxygen is not water

(8 marks)

Examiner's Comments

The candidate lost one mark because his/her explanation of why saltwater fish die when placed in freshwater was not complete. The expected response was *freshwater enters the fish through osmosis, causing the cells to swell and burst. The fish then die*.

General Comments

Many candidates were unable to state the process involved in each observation. Such candidates confused the concepts of diffusion and osmosis. Other candidates were able to state whether the observation occurred because of diffusion or osmosis but were unable to provide reasons.

Candidate's Response to Part (e) (i)

(e) At school, Mona is studying the structure of specialized plant and animal tissues such as xylem vessels and red blood cells. She notes that xylem vessels and red blood cells have unique structures.

(i) Explain to Mona TWO ways in which the structure of the xylem vessel is uniquely suited for its functions. Write your responses under the headings in Table 2.

TABLE 2: STRUCTURE AND FUNCTION OF XYLEM VESSELS

Structure of xylem vessels	Explanation
1. Made up of the strong Lignin compound.	This acts as the support of plants as the strong Lignin is like a column going up the stem and will hold the plant upright.
2. ~~Hexagonal~~ Very small in diameter.	this allows for capillarity action to occur, which allows water to be directed more easily up the xylem and to the leaf.

(4 marks)

Examiner's Comments

The candidate was able to explain the correlation between the structure and function of xylem vessels.

Candidate's Response to Part (e) (ii)

(ii) Explain to Mona TWO ways in which the structure of the red blood cell is uniquely suited to its functions. Write your responses under the headings in Table 3.

TABLE 3: STRUCTURE AND FUNCTION OF RED BLOOD CELLS

Structure of red blood cells	Explanation
1. Biconcave disk shape.	This is to allow the storage of more oxygen in the red blood cell to transport around the body.
2. No nucleus.	While the nucleus is there, it is extremly small, this allows for more oxygen to be attached into the red blood cell to be carried around the body.

(4 marks)

Examiner's Comments

The candidate was able to explain the correlation between the structure and function of red blood cells.

The candidate began the second response using a flawed statement which was 'while the nucleus is there, it is extremely small'. The candidate was not penalized for giving this information because he/she had already stated that the mature red blood cell has no nucleus.

Recommendations

- Candidates are encouraged to read the question carefully before crafting a response.
- Students must practise writing and testing suitable hypotheses in class. Most candidates were unable to write a suitable hypothesis for the experiment given and so they lost valuable marks. Students need to be reminded that a hypothesis is a suggested reason for their observation(s). A hypothesis can be tested and relates directly to the observations made.

Question 2

This question tested the following specific objectives from Section C (Continuity and Variation) of the syllabus: 2.1, 2.10 and 3.1. The profile skills assessed were Knowledge and Comprehension (KC) and Use of Knowledge (UK).

Candidates were required to

- describe the process of mitosis (Names of stages were not required.)
- describe the mechanism of sex determination and inheritance of sex-linked diseases in humans
- explain how genetic variation arises.

Candidate's Response to Part (a) (i)

(a) Figure 2 is a series of randomly placed diagrams, labelled A–E, showing the stages of mitosis in a plant cell.

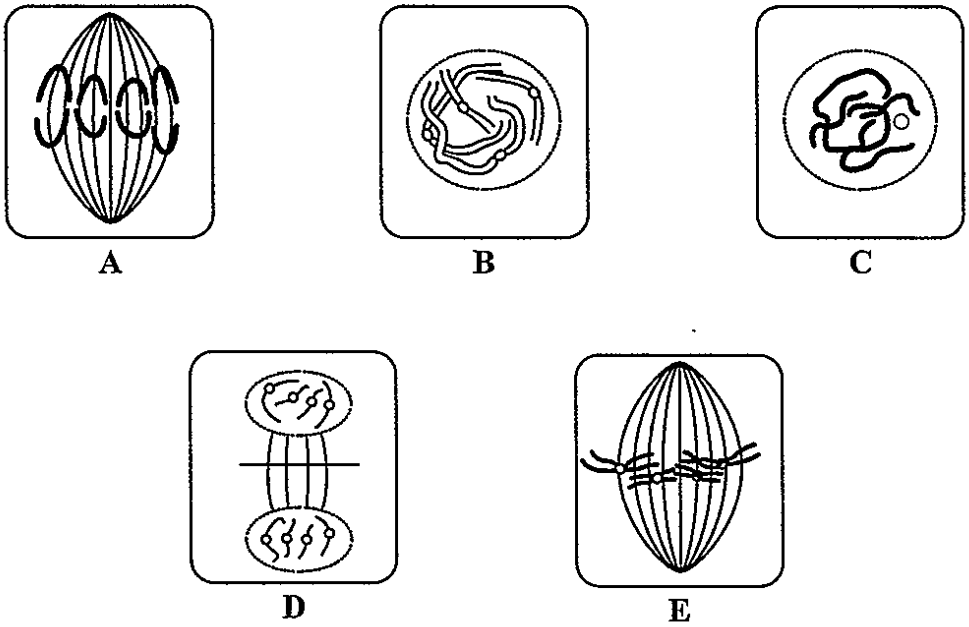


Figure 2. Mitosis in a plant cell

(Holbrook Bio I, https://groups.diigo.com/group/laycomfievie/content/answers-to-mitosis-worksheet-10321668)

(i) How many chromosomes are in the parent cell of this plant?

4 ✔

(1 mark)

Examiner's Comments

The candidate gave the correct answer — Four chromosomes are in the parent cell of the plant.

Candidate's Response to Part (a) (ii)

(ii) Using the letter labels A–E to show order, state the stages in the **correct** order of mitosis.

C, B, E, A, D

(2 marks)

Examiner's Comments

The candidate gave the letter labels in the correct order to accurately to represent the sequence of the stages of mitosis.

Candidate's Response to Part (a) (iii)

(iii) State TWO reasons why mitosis is important to living organisms.

* For the creation of new cells if the organism was injured
* ~~For~~ ~~to~~For duplicating cells in sexual ~~repro~~ reproduction

(2 marks)

Examiner's Comments

The candidate was able to state clearly two reasons why mitosis is important to living organisms.

General Comments

Many candidates were able to gain at least one mark out of two on this part. Candidates gave many responses that were correct. The most frequent responses were as follows.

- Growth and repair
- Asexual reproduction
- Replacing old cells with new ones

Marks were not awarded for the following responses. An explanation of why each response is incorrect is given

- Development of organism — Development refers to functional and behavioural changes while growth refers to physical and biological changes. Candidates were awarded a mark for stating *growth*.
- Reproduction — This answer is vague. The candidate needed to be specific by stating asexual reproduction or by providing a specific example of asexual reproduction.
- Maintenance of cells — This is a vague response.

Candidate's Response to Part (b)

(b) List TWO ways by which genetic variation occurs in living organisms.

① Crossing over in meiosis

② The random alignment of chromosomes along the equator determines the unpredictable groupings.

(2 marks)

Examiner's Comments

The candidate correctly listed two ways by which genetic variation occurs in living organisms.

Candidate's Response to Part (c)

(c) "The probability of a child being male or female is the same each time a child is conceived." Determine the accuracy of this statement by completing the following genetic diagram.

Parents' phenotypes female XX x male XY

Parents' genotypes XX x XY

Gametes X X x X Y

Offspring genotypes

	X	X
X	XX	XX
Y	XY	XY

Conclusion

It is diff the same each time because no matter what there is always a 50% chance of it being a female and a 50% chance of it being a male.

(6 marks)

Examiner's Comments

The candidate was able to complete the genetic diagram by inserting the correct parental genotypes to match the parental phenotypes. The gametes were also represented in the right manner and the Punnett square was used to determine the genotypes of the offspring.

The candidate was able to determine, using the information on the Punnett square, that for each pregnancy, there is a 50 per cent chance of a male being born and a 50 per cent chance of a female being born.

General Comments

Many candidates wrote the correct conclusion but were unable to complete the Punnett square accurately.

Candidate's Response to Part (d)

(d) List the TWO possible genotypes of a female whose father is a haemophiliac and whose mother carries the allele for haemophilia.

$X^H X^h$ or $X^h X^h$

	X^h	Y
X^H	$X^H X^h$	
X^h	$X^h X^h$	

(2 marks)

Total 15 marks

Examiner's Comments

The candidate was able to list two possible genotypes of a female whose father is a haemophiliac and whose mother carries the allele for haemophilia, a sex-linked disease in humans.

General Comments

Many candidates understood that the likelihood of having haemophilia is linked to a person's sex. Therefore, they needed to use XX to represent the female and XY to represent the male.

It should also be noted that some candidates accurately assigned the letter H in superscript form. Other candidates wrote the letter H in subscript form. Doing so was incorrect.

Recommendations

Based on the responses given by candidates, it could be determined that there were candidates who knew and understood the terminology used in genetics and others who were merely acquainted with the terms.

In teaching this part of the syllabus, teachers should ensure that the students know the terminology (genetic jargon) and can use the terms accurately. It seemed that some candidates did not understand the difference between genotype and phenotype and failed to recognize that gametes are haploid, whereas the parents are diploid. There were instances where candidates represented gametes as diploid and the offspring as triploid or tetraploid.

However, many candidates were able to state clearly that for each pregnancy, there is a 50 per cent chance of a male being born and a 50 per cent chance of a female being born. The correct conclusion was made even by candidates who completed the Punnett square incorrectly. This indicates a basic understanding of the concept of sex determination but points to the deeper problem of lack of understanding of the terminology and subsequent mechanism of the crosses.

The last part of the question, which was based on sex-linked diseases in humans, was poorly done. Students need more practice in manipulating the superscripts that are placed on the X chromosomes. Some candidates wrote subscripts and referred to a male haemophiliac in their response even though they were asked to give the relevant genotypes of a female.

Question 3

This question tested the following specific objectives from Section B (Life Processes and Disease) of the syllabus: 4.12, 4.13, 8.3. Additionally, the two profile skill areas assessed were Knowledge and Comprehension (KC) and Use of Knowledge (UK). The question examined candidates' knowledge of storage in living organisms and the changes that occur in a seed during germination.

Candidate's Response to Part (a) (i) to (ii)

(a) In the appropriate columns in Table 4,

(i) list TWO substances **other than** starch and sugar, that are stored in plants. **(2 marks)**

(ii) state where in the plant EACH substance listed in (a) (i) is stored. **(2 marks)**

TABLE 4: PLANT STORAGE

(i) Substance Stored in Plant	(ii) Site of Storage in Plant
~~amino acids~~ protein ~~amino acids~~ ~~glucose~~	endosperm/cotyledon
calcium oxalate	bark, ~~leaf~~

Examiner's Comments

The candidate identified two substances, other than starch, stored in plants. He/she was also able to accurately identify storage sites in plants of the substances given in Part 3 (a) (i).

General Comments

Some candidates gave incorrect answers such as 'plants store sunlight or carbon dioxide'. Others provided vague answers such as 'plants store nutrients'.

While some candidates gained the mark for Part 3 (a) (i), they stated an inaccurate site of storage in Part 3 (a) (ii). In addition, there were candidates who incorrectly stated that carbon dioxide is stored in the stomata.

Candidate's Response to Part (b)

(b) State THREE reasons why storing food is important to living organisms.

It discontinues the need for continuous manufacture of food in photosynthesizing plants, as continuous food intake in heterotrophic organisms such as humans. It provides food reserves in periods of unfavourable conditions in plants where photosynthesis does not occur, and allows for rapid growth in periods of favourable conditions. It provides a means of reproduction via storage organs in plants that is quick and plentiful in number which allows the plant to colonise areas.

(3 marks)

Examiner's Comments

The candidate identified three reasons why storing food is important in living animals.

General Comments

Some candidates referenced economic gain along with the existence of a variety of seasons as reasons why storing food is important. These reasons were not accepted.

Candidate's Response to Part (c) (i)

(c) Figure 3 is a graph that shows changes in the amount of starch, sugar and protein in a seed during the pre-germination, germination and post-germination stages.

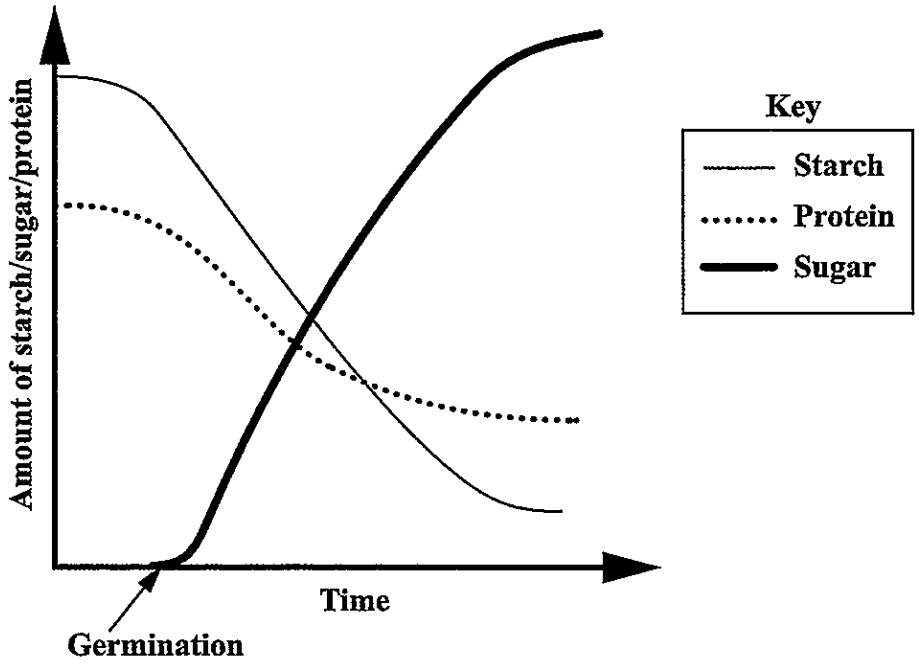


Figure 3. Graph showing changes in the amount of starch, sugar and protein in a seed during pre-germination, germination and post-germination stages

(i) Explain the decrease in the amount of protein in the seed as it germinates.

enzymes
amino acid
nutrients

As the seed germinates, it uses up the protein stored in its ~~cotyledons or endosperm~~ as it is growing and protein is essential in growth and repair of cells, as well as manufacture of enzymes to carry out essential metabolic processes. Protein is broken down to amino acids to provide nutrients for the plant. Protein is also used in manufacture of gametes like the embryo where it is stored.

(3 marks)

Examiner's Comments

The candidate accurately explained why there was a decrease in proteins in the germinating seeds.

General Comments

Most candidates could not explain why the proteins decreased in the germinating seed. The following are the common errors made by candidates.

- Some candidates simply opted to rewrite what was written in the question.
- The terms *pre-germination* and *post-germination* were confused.
- Some candidates described the curve rather than explaining what occurred. This may indicate that such candidates had difficulty distinguishing between the verbs *describe* and *explain*.

Candidate's Response to Part (c) (ii)

(ii) Explain the change in the level of starch as the seed germinates.

As the seed germinates, starch is converted to maltose by amylase which is further converted to glucose ✓ by maltase as glucose is soluble and ✓ needed for ~~A~~ energy production in plants. The germinating seed requires plenty energy as it is growing and growth requires energy to occur. Therefore, glucose levels in the plant is seen to increase while starch stored decreases. Starch is decreased as it is ~~the~~ means of storage in the ~~plant~~'s cotyledon and endosperm waiting for enzymes to be activated to break down the food store. (2 marks)

Examiner's Comments

The candidate accurately explained the change in the level of starch as the seed germinates.

General Comments

Many candidates could not explain the change in the starch level within the seed as it germinates.

Candidate's Response to Part (c) (iii)

(iii) Namé the sugar which is MOST li[illegible]y represented in Figure 3.

The sugar is most likely glucose.

(1 mark)

Examiner's Comments

The candidate was able to identify the product of starch digestion.

General Comments

The most common misconception was that the sugar shown was sucrose instead of glucose.

Candidate's Response to Part (c) (iv)

(iv) Outline ONE reason why starch is the preferred storage material in plants.

Starch in a large insoluble polypeptide. Therefore, when stored in plants cells, it would not interfere with other chemical reactions that occur. Starch is therefore stored until it is ready to be broken down glucose for respiration.

(2 marks)

Examiner's Comments

The candidate was able to outline one reason why starch is the preferred storage material in plants.

General Comments

Some candidates used the terms *less soluble* and *less reactive* when they should have stated *insoluble* and *unreactive*. Additionally, another misconception was that starch is soluble and therefore it is easily distributed when required.

Recommendations

Teachers and students should take note of the following recommendations.

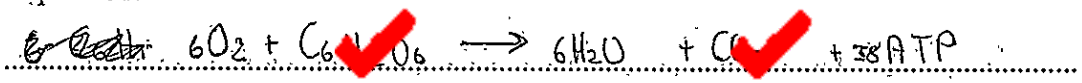
- Students should review common terminology and be able to differentiate between verbs and terms. Examples of such include *describe* and *explain* and *pre-germination* and *post-germination*.
- Teachers should incorporate activities and labs that help students to gain more knowledge of the process of germination. This would ensure that students are more familiar with concepts such as where growth occurs in germinating seeds.
- Teachers should review with students the basic information related to proteins. For example, students should be aware that proteins comprise amino acids and if proteins are broken down, they are broken down into amino acids.

Question 4

This question tested the following specific objectives from Section B (Life Processes and Disease) of the syllabus: 3.1, 3.2, 3.3. Additionally, the two profile skill areas assessed were Knowledge and Comprehension (KC) and Use of Knowledge (UK). The question examined candidates' comprehension of aerobic and anaerobic respiration, the impact of smoking on health and techniques that may be employed to reduce the number of people smoking.

Candidate's Response to Part (a)

(a) Write a balanced chemical equation to show the reactants and final products of aerobic respiration.



(2 marks)

Examiner's Comments

The candidate wrote a balanced equation, showing all the reactants and products of aerobic respiration.

General Comments

Overall, some candidates misunderstood what was required. Some candidates provided the equation for photosynthesis while other candidates were unable to balance the equation even if the other information was accurate. In addition, some candidates did not provide all the reactants or products. In some instances, candidates provided a word equation rather than a chemical equation.

Candidate's Response to Part (b)

(b) State TWO ways in which aerobic respiration differs from anaerobic respiration. Write your responses in the appropriate columns in Table 5.

TABLE 5: AEROBIC AND ANAEROBIC RESPIRATION

Aerobic Respiration	Anaerobic Respiration
1. This process requires oxyen	This process does not require oxygen
2. This process produces a large amount of energy	This process produces a small amount of energy.

(4 marks)

Examiner's Comments

The candidate stated two ways in which aerobic respiration differs from anaerobic respiration.

General Comments

Some candidates did not receive the allocated marks because they

- did not provide a complete comparison
- confused aerobic and anaerobic respiration with breathing and gaseous exchange
- interpreted anaerobic and aerobic respiration to mean nonliving and living, respectively.

It should be noted that while most candidates were able to provide at least a partially accurate response, some candidates confused aerobic and anaerobic respiration.

Candidate's Response to Part (c)

(c) James represented his school at the national sports meet and ran the 100 m race. After winning the race, James could not immediately speak with the reporters because he was gasping for air and was also feeling intense pain.

His friends helped him off the track to rest a bit and catch his breath. With time, James recovered and was able to complete his interview and celebrate with his team.

Explain why James was feeling intense pain and gasping for air after his race.

~~After~~ During the race James was respiring very fast which caused him to respire faster than he was getting oxygen in order to aerobically respirate. Therefore because of the lack of oxygen he began to anaerobically respirate. During anaerobic respiration lactic acid is produced which is harmful to the body and causes muscle cramps and fatigue. Lactic acid is broken down by oxygen. Lactic acid being broken down by oxygen is called 'repaying the oxygen debt'. After winning the race, James could not immediately talk because he was trying to take in oxygen to ~~be~~ aerobically respire and break down the lactic acid to stop the pain ~~in his legs~~ he was experiencing. With time, James was back to aerobically respirating and able to talk and experience little to no pain in his legs.

(4 marks)

Examiner's Comments

The candidate was able to clearly explain why James was feeling pain and why he was gasping for air after the race.

General Comments

Some candidates did not receive the allocated marks because they

- did not associate the buildup of lactic acid with causing pain or fatigue
- indicated that the pain felt by James was as a result of him being out of shape/unfit or unhealthy
- provided information regarding what should be done before the race (for example, stretching and training) or during the race (for example, breathing better)
- indicated that the changes observed in James were due to a preexisting medical condition, for example, asthma. Others also mentioned poor nutrition and difficulty with circulation, which indicated that James had entered oxygen debt but they did not indicate that oxygen was required to repay this debt or to break down/get rid of the lactic acid.

Candidate's Response to Part (d) (i)

(d) Mr Smith has been smoking cigarettes for ten years. During his most recent doctor visit, the doctor outlined many negative effects of smoking. Mr Smith agreed that smoking was not good for his health.

(i) Explain TWO negative effects that smoking for such a long period would have had on Mr Smith's health.

① Smoking produces ✓ on the lungs which coves the alveoli which reduces its effeciency in gaseous exchange. This therefore reduces the amount of ~~gases~~ ~~diffusing in~~ of CO_2 and oxygen diffusing in the alveoli this causes a reduction of oxygen ✓ being ~~to~~ available ~~to~~ which leads to a shortness of breath.

② ~~Emphesyma can be caused~~

② The cells in the alveoli can mutate due to the tar ✓ in the lungs and form into cancer cells. This causes lung canc✓ which can result in death if smoking continues or no treatment is taken.

Examiner's Comments

The candidate was able to explain two negative effects that smoking would have on Mr Smith's health.

General Comments

Some candidates did not receive the allocated marks because they provided a list of effects without explaining two of them or without linking them appropriately to cigarette smoke. Additionally, some candidates simply stated that cigarettes were 'bad for health'. This statement was too vague.

Candidate's Response to Part (d) (ii)

(ii) Suggest ONE action that governments can take to address smoking on a national level.

(i) Ban the sale of cigarettes.

Examiner's Comments
The candidate was able to suggest one action that governments can take to address smoking on a national level.

Recommendations

Teachers and students should take note of the following recommendations.

- Teachers should ensure that students gain an understanding of reactants, products and balancing equations.
- Teachers' instruction should include scenario-based situations and case studies on topics such as anaerobic respiration in multiple cells, fermentation and bread baking. Doing so may help students to develop a greater understanding of this concept.

Question 5

This question tested the following sections and specific objectives from the syllabus.

- Section A — Living Organisms in the Environment: 6.2
- Section B — Life Processes and Disease: 7.1, 7.2 and 7.6

For this question, candidates were required to

- define the terms *stimulus* and *response*
- label a reflex arc diagram of the knee jerk reflex
- suggest a biological reason why a case subject would not have responded to a sharp tap on the patellar tendon
- explain the response of millipedes to any two stimuli
- suggest two consequences of disruption to a water ecosystem caused by artificial lighting.

Candidate's Response to Part (a) (i)

(a) Define EACH of the following terms.

(i) Stimulus

A change in the internal or external environment in an organism which initiates a response.

Examiner's Comments

The candidate defined the term *stimulus* correctly.

General Comments

Some candidates gave definitions for receptor and effector. There were also candidates who gave non-biological definitions for stimulus. Such candidates defined the a stimulus as 'an incentive'.

Candidate's Response to Part (a) (ii)

(ii) Response

The action carried out by the effector in response to stimuli.

(2 marks)

Examiner's Comments
The candidate defined the term *response* correctly.

Candidate's Response to Part (b) (i)

(b) (i) Figure 4 shows the reflex arc diagram for the knee jerk reflex. Identify EACH of the parts labelled A, B, C and D.

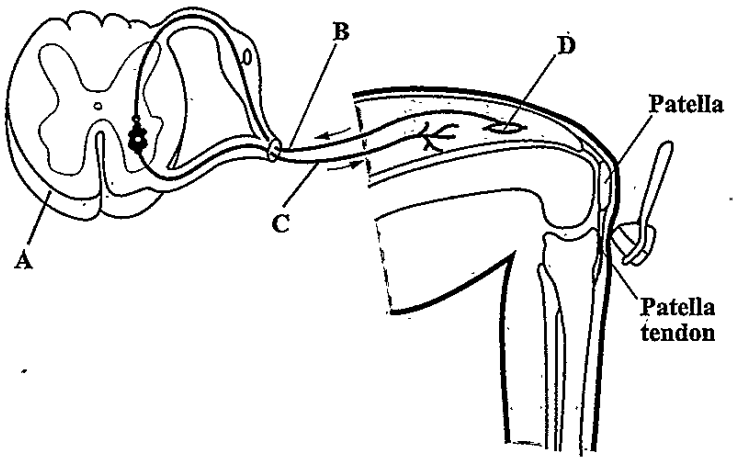


Figure 4. Reflex arc diagram for the knee jerk reflex

A Spinal chord

B Sensory neuron

C Motor neuron

D Receptor

(4 marks)

Examiner's Comments

The candidate labelled the diagram correctly.

General Comments

Of all the parts, D was most often labelled incorrectly.

The expected responses were as follows.
A — Spinal cord
B — Sensory neuron
C — Motor neuron
D — Stretch receptor

Candidate's Response to Part (b) (ii)

(ii) Usually, people who undergo the knee jerk reflex test respond to the sharp tap on the patellar tendon with a sudden kicking movement of the lower leg. Timothy did not have this response and, instead, sat still during the test.

Suggest ONE biological reason why Timothy did not have the expected knee jerk reflex.

He has receptors. He does not have working receptors on his patella tendon.

(1 mark)

Examiner's Comments

The candidate suggested a correct biological reason.

General Comments

Only biological reasons were accepted. Therefore, answers such as 'the intensity of the tap' or other non-biological reasons were not accepted.

Other accepted responses were as follows.

- Damage to the nerves responsible for transmitting the impulses
- Damage to his central nervous system
- Missing/no receptors and therefore his body cannot respond to the stimuli
- Genetic reasons were also accepted

Candidate's Response to Part (c)

(c) Molly was extremely concerned when she realized that there were hundreds of millipedes in her basement. The pest control team explained to Molly that the millipedes were likely responding positively to stimuli in the basement.

Explain the response of millipedes to any TWO stimuli that may be present in the basement.

The basement would be dark, thereby attracting millipedes towards the dark areas away from bright light. Millipedes like many insects live inside of soil or in dark areas hence why the basement attracted the millipedes as it provided them a home where they can be easily hidden from predators. The atmosphere of the basement is colder and is moist/humid which attracts the millipedes to grow and breed in this area with barely and any human activity. These conditions combined allowed the millipede colony to thrive and grow. The millipedes are attracted to the moist/humid conditions as it provides their bodies with moisture.

BOD

Examiner's Comments

The candidate identified two stimuli, stated why the millipedes moved towards the stimuli and explained the millipedes' response to each stimulus. Candidates who stated that the millipede colony was able to thrive in their response were awarded a mark.

General Comments

This section was poorly done because many candidates did not seem to be aware of the stimuli that invertebrates, such as millipedes, respond to. Candidates received marks for correctly listing the stimuli, the organism's response to the stimuli and an explanation for the organism's response. Other acceptable responses are provided below.

- The basement may have small cracks. The millipedes will move into these cracks and crevices, and this will make them harder to be seen and reached by predators.
- Cool temperature is another stimulus. Millipedes move to areas where the temperature is cool because high or extreme temperatures can affect enzyme activity.

Candidate's Response to Part (d)

(d) *Daphnia* are zoo plankton invertebrates which come to the surface of the water while it is dark, so they can feed on algae. However, in nearshore communities artificial lighting is used to light the waterways such as ponds and rivers.

Suggest TWO consequences of the disruption to the water ecosystem which is caused by artificial lighting.

The Daphnia are no longer able to come to the surface and feed, therefore leading to them potentially starving and dying out. This effects the entire ecosystem as organisms that may have fed on Daphnia lose a source of food.

Examiner's Comments

The candidate suggested two consequences of the disruption to the water ecosystem that are caused by artificial lighting.

General Comments

Overall, this section was well done. Some other accepted responses include the following.

- Daphnia will not be able to feed on algae; therefore, this leads to algal bloom.
- Daphnia (and other organisms) may migrate to other areas (to feed).
- There will be a reduction of the water quality.
- Algal bloom will prevent light from penetrating further into the water.
- Submerged plants cannot photosynthesize and therefore they die.

Recommendations

Many candidates were not familiar with the reflex arc diagram for knee jerk reflex and lost marks for providing inaccurate labels. It is recommended that teachers incorporate classroom activities during which students have to focus on the labelling of similar diagrams.

Candidates are often unable to provide biological explanations for scenarios that are presented. Even though non-biological reasons are possible for some of the questions asked, candidates should limit their responses to only biological explanations, especially when such a prompt is given in the stem of the question.

Lastly, many candidates tend to lose marks on essay type questions which require explanations to support the answer provided. For example, many candidates were able to accurately provide the stimuli in Part (c) but failed to explain the response to the stated stimuli.

Question 6

This question tested the following specific objectives from Section B (Life Processes and Disease) of the syllabus: 9.5 and 9.6. Candidates' knowledge and comprehension of birth control methods and how they work to prevent pregnancy was examined. Candidates were also required to apply their knowledge of HIV/AIDs. A table which showed the HIV and AIDS summary statistics for the Caribbean was provided and candidates were required to perform a calculation based on these statistics. Overall, the question was attempted and answered by most candidates.

Candidate's Response to Part (a)

(a) List FOUR birth control methods.

Four birth control methods are female condoms, male condoms, ~~&~~ contraceptive pills (birth control pills) and a vasectomy (~~fem~~ the removal of the organ which produces gametes).

(4 marks)

Examiner's Comments

Four correct birth control methods were listed by the candidate.

General Comments

Overall, candidates did well on this section. Other acceptable answers were as follows.

- Diaphragm or cap
- Contraceptive patch or implant
- Spermicides
- Withdrawal method
- Rhythm method

Candidate's Response to Part (b)

Janet does not want to become pregnant at this time. She is therefore seeking recommendations for a suitable birth control method.

Outline to Janet how any TWO of the methods listed in (a) work to prevent pregnancy.

The contraceptive pill contains either progestin progesterone only or oestrogen and progesterone. These two hormones prevent inhibit the levels of Follicle Stimulating Hormone, preventing ovulation, thus pregnancy.

• The condom is a sheet of rubber rolled over the erect penis before intercourse. This prevents the sperm from entering the uterus during intercourse, preventing fertilization fertilization and thus pregnancy.

Examiner's Comments

The candidate correctly outlined how condoms and birth control pills work to prevent pregnancy. Other popular methods outlined by candidates included

- abstinence — there is no sexual intercourse, so no pregnancy is possible.
- The withdrawal method — prevents sperm or ejaculate from entering the vagina/no sperm is deposited in the vagina so no pregnancy or fertilization occurs.
- Rhythm method — pinpoint ovulation and avoid intercourse during this time to prevent pregnancy

General Comments

Some candidates were unfamiliar with how intrauterine devices (IUDs), a vasectomy or the hormonal contraceptive pill work to prevent pregnancy. No marks were awarded for simply describing how the contraceptive pill should be administered or how effective it is.

Candidate's Response to Part (c) (i)

(c) Table 6 shows HIV and AIDS summary statistics for the Caribbean in the year 2020 obtained from a UNAIDS fact sheet.

TABLE 6: HIV AND AIDS STATISTICS FOR THE CARIBBEAN, 2020

People Living With HIV	Total New HIV Infections	AIDS-related Deaths	People Accessing Treatment
330 000	13 000	6000	220 000

Source: UNAIDS Fact Sheet, World Aids Day, 2022. unaids.org

(i) Calculate the percentage of HIV-positive persons in the Caribbean who did NOT access treatment in 2020.

330,000 - 220,000 = 110,000

$\frac{110,000}{330,000} \times 100 = 33.3\%$

(2 marks)

Examiner's Comments

The candidate arrived at the final answer, *33.3%,* after performing the correct mathematical calculation in two steps. It must be noted that the candidate showed all the working.

General Comments

Candidates were awarded a mark for giving the correct formula or working, even if the final percentage was not exactly 33.3%. However, many candidates were confused by the data in the table and incorrectly added the information in the first two columns when doing so was not necessary. The resulting answer was incorrect and therefore such candidates were awarded no marks.

Candidate's Response to Part (c) (ii)

(ii) Suggest TWO reasons why people, despite having HIV, may not access treatment for the disease.

Having HIV ~~is seen as~~ can be seen as embarrassing in society. Persons affected by may be hesistant to get treated as having HIV comes with the stigma of being a "whore" or being "unclean" in people's eyes.

Accessing treatment of HIV can be expensive also. Communities with high numbers of HIV cases ~~do~~ tend to be the poorer ones, where having a lot of sex is considered an inexpensive passtime. Persons in such communities, even though they may have the desire, would be unable to seek the help they need.

(4 marks)

Examiner's Comments

The candidate provided and explained two reasons why people may not access treatment despite having HIV.

General Comments

In some instances, candidates listed reasons why people may not access treatment despite having HIV but did not provide an explanation. Such candidates were awarded no marks. Some other common reasons that were accepted include

- the stigma associated with having the disease may prevent persons from accessing treatment. Additionally, they may be scorned or alienated from society if people know that they have the disease. As such, they will be embarrassed and avoid accessing treatment.
- lack of education or general awareness of the severity of the disease and this may lead persons to think that they can manage the disease on their own/or that their immune system is capable of fighting off disease.

Candidate's Response to Part (c) (iii)

(iii) Persons with AIDS may sometimes die because they have an opportunistic (secondary) infection such as tuberculosis, which is caused by a bacterium. Explain why persons with AIDS may die as a result of an opportunistic (secondary) infection.

Acquired Immunodeficiency Syndrome (AIDS) is caused by the Human Immunodeficiency Virus (HIV). Persons infected by HIV will not have immediate effects but the the effects become overtime as persons notice that they become sick a lot more frequently and heavily. This is due to HIV breaking down the immune system rendering it largely incapable of defending against pathogens. Persons by this point have developed AIDS and are now highly susceptible to bacterial and viral diseases with the inability to fight them off. This is why death from opportunistic infections is very likely in AIDS cases.

(3 marks)

Examiner's Comments

The candidate identified the three relevant points.

General Comments

Few candidates were able to gain the full three marks. Many candidates were able to indicate one or two points only. A misconception by many candidates was that AIDS is an autoimmune disease. Overall, candidates were awarded three marks if the three main points were provided.

- The immune system is severely damaged/weakened in a person who has AIDS (one mark)
- The immune system is no longer able to destroy organisms (viruses, bacteria or fungi) which can cause disease (one mark)
- These organisms multiply/reproduce and overwhelm the host causing the host's condition to worsen (one mark)

Recommendations

Candidates generally struggle with interpreting and analysing data from tables and would therefore benefit from practising these skills using relevant examples. Additional emphasis should be placed on ensuring that students know how to do calculations related to the statistics they may be given and that they fully understand the various birth control methods and how they work.

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

Question 1

This question tested the following sections and specific objectives from the syllabus.

- Section A — Living Organisms in the Environment: 2.3
- Section B — Life Processes and Disease: 8.2 and B 8.3

The profile skills assessed were Experimental Skills (XS) and Use of Knowledge (UK).

For Question 1 candidates were required to

- investigate the degree of water retention (the water-holding capacity) of three different types of soils
- describe the structure of a dicotyledonous seed
- describe the processes taking place within a seed during germination.

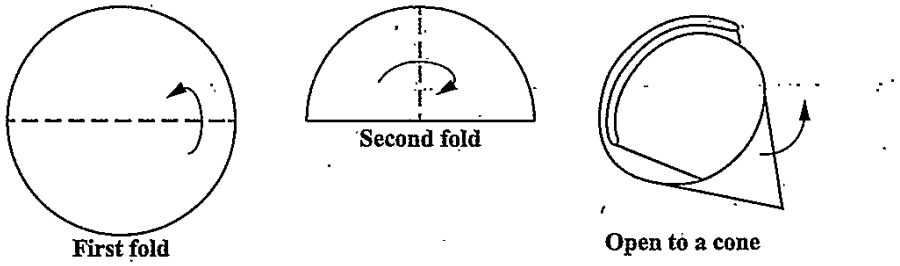
You are provided with three samples of soil labelled A, B, and C. Additionally, you are provided with the following pieces of equipment and materials to carry out the investigation.

Equipment and materials

- 100 g samples of soil labelled A, B and C
- 4 measuring cylinders (100 mL)
- 3 filter funnels
- 3 beakers (250 mL)
- Stopwatch or clock in a visible place
- 3 sheets of circular filter paper (12.5 cm in diameter)
- Paper towels
- Masking tape for labelling

Procedure

1. Fold EACH filter paper in half, then in half again so that each paper has four layers. Form a cone with each filter paper as shown in the diagrams below.



2. Place EACH cone into a funnel and place the funnel over a dry measuring cylinder.
3. Label the measuring cylinders A, B, and C.
4. Place Soil A into the cone in the funnel on Measuring cylinder A.
5. Place Soil B into the cone in the funnel on Measuring cylinder B.
6. Place Soil C into the cone in the funnel on Measuring cylinder C.
7. Using the fourth measuring cylinder, place 100 mL of tap water into EACH beaker.

8. Quickly pour the water from one of the beakers into Soil sample A and record the time it takes for water to pass through Soil sample A.

9. Record the volume of water in Measuring cylinder A after the water has drained through Soil sample A.

10. **Repeat** Steps 8 and 9 using Soil sample B and Soil sample C.

11. Calculate the volume of water retained by Soil samples A, B and C.

12. Construct a suitable table and record your results for Steps 8–11 in the space provided below.

While you are waiting for the water to pass through the soil samples, you are advised to begin Question 2 while continually monitoring the soil samples.

Candidate's Response to Part (a)

(a) Table of Results

	A	B	C
Time taken	3 mins 25 seconds	2 mins 13 seconds	1 mins 29 seconds
Amount of water drained through (cm³)	~~90.2~~ ~~90.2~~ 91.0	90.2	80.8
Amount of water retained in soil (cm³)	4.0 ~~9.2~~	9.8	10.2 29
Water holding capacity of soil (cm³/g)			

Examiner's Comments

The candidate was awarded full marks because the table was drawn neatly and was enclosed. In addition, the headings were correct, the units were stated and the data was correct/plausible.

General Comments

Generally, candidates found it challenging to present a complete table which captured all the relevant results. It must be noted that candidates drew various types of tables and that very few candidates received full marks. Candidates lost marks for the following.

- Failing to record the time taken for each soil type to be completely drained. The units (minutes and/or seconds) were often omitted and in many cases, the symbol for minutes was incorrectly given as 'm'.
- Failing to include the appropriate headings, particularly to distinguish between the volume drained and that retained. The units given for the volume included ml^3 instead of cm^3 or ml.
- Confusing the terms *drained* and *retained*.
- Failing to include all the necessary headings and columns and not fully enclosing them.
- Giving a qualitative report which included a few values in lieu of a completely drawn table with results.
- Recording feasible values but not indicating which times were the fastest and slowest.
- Neglecting to calculate the volume retained even though it involved a simple subtraction of the volume drained from 100ml.

Candidate's Response to Part (b) (i)

(b) (i) Through which soil sample did the water flow the **quickest?**

Sample A

(1 mark)

Examiner's Comments

The candidate gave a correct response based on the data provided.

Candidate's Response to Part (b) (ii)

(ii) Through which soil sample did the water flow the **slowest**?

Sample C

(1 mark)

Examiner's Comments

The candidate gave the correct response based on the data provided.

General Comments for Part (b) (i) and Part (ii)

Even though Sample A was expected to be the fastest-draining soil and Sample B the slowest-draining, there were instances when this was not borne out by the results sent to CXC by the supervisors of the examination. In such instances, the Supervisor's Report and the candidates' results were used to determine the marks given.

Candidate's Response to Part (c)

(c) Suggest a suitable title for the investigation.

To investigate the water retention in three (3) different types of soil

(1 mark)

Examiner's Comments

The candidate provided a suitable title for the experiment.

General Comments

Most candidates were able to suggest a suitable title for the experiment. However, some candidates focused on the drainage property of the soil rather than the water retention or water-holding capacity of each type.

Candidate's Response to Part (d) (i)

(d) (i) Use the data in the table constructed in (a) to determine which soil is the clayey soil.

Sample C

(1 mark)

Examiner's Comments

The data provided by the candidate substantiated the answer given.

Candidate's Response to Part (d) (ii)

(ii) State TWO reasons to justify your answer in (d) (i).

(1) Sample C retained more water which is a property of clayey soil.

(2) Sample C took a longer time for water to pass through

(2 marks)

Examiner's Comments

The candidate accurately stated two reasons for the answer given in Part (d) (i).

General Comments for Part d (i) and Part (d) (ii)

This section was very well done and it was evident from the general performance of candidates that significant practical work was done in covering this topic. Overall, candidates were able to state that clay particles are small with very little air spaces. These characteristics prevent water from draining through it quickly; therefore, this soil type retained the most water.

The clumping property of clay particles was also mentioned by many candidates.

Candidate's Response to Part (e)

(e) Figure 1 shows the internal structure of a seed.

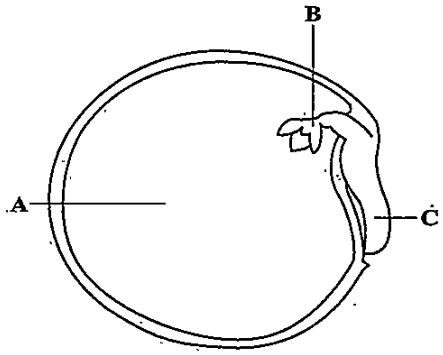


Figure 1. Internal structure of a seed

Explain why Structure A is much larger than structures B and C.

Structure A is known as the ~~cote~~ cotyledons where all the food is stored and absorbed in order for plants to carry out the germination process needing a larger area ~~areas~~ to store and carry out the processes where as structure B the radicle grows using ~~uses~~ the nutrients to produce a shoot and structure C the plumule (2 marks)

Examiner's Comments

The candidate was awarded one mark for stating that the cotyledon was a food store. However, he/she misnamed B and C. The correct names are B — *plumule* and C — *radicle*. The plumule and the radicle are smaller because they are not storing food at that stage.

General Comments

In this section very few candidates scored both marks because even though most of them were able to identify the structure labelled A in Figure 1 as the cotyledon (which contains stored food/nutrients), they failed to mention that the plumule (B) and radicle (C) are smaller because they do not store food.

Some candidates identified Figure 1 as 'the human eye' even though the diagram was labelled as the "Internal structure of a seed".

Candidate's Response to Part (f) (i)

(f) Figure 2 is a graph showing the results of an experiment on germinating small, medium and large kidney beans over a five-day period. All of the seeds received the same conditions for growth.

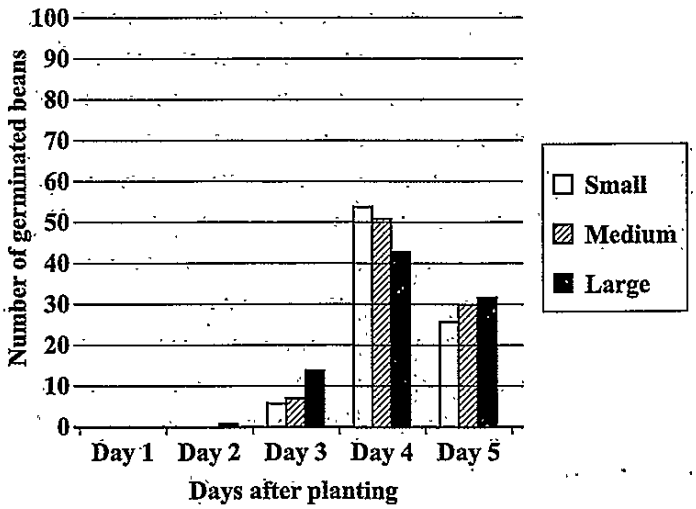


Figure 2. Number of beans that germinated each day

(i) Suggest ONE reason why no seeds germinated on Day 1.

There were no seeds germinated as they were freshly planted and so needed time to absorb all the nutrients needed to germinate **(1 mark)**

Examiner's Comments

The candidate gave a suitable answer.

General Comments

Some candidates correctly stated that water was needed to initiate the process of germination but failed to indicate that the water was taken in to activate the enzymes. There were candidates who suggested that the seeds were recently planted and needed the time to start germinating.

Candidate's Response to Part (f) (ii)

(ii) Suggest ONE reason why there was a large increase in the number of germinating seeds on Day 4.

They were all accumulating and absorbed all the nutrients needed to germinate

(1 mark)

Examiner's Comments

The candidate provided a suitable answer.

General Comments

This section was well done, as most candidates scored full marks. It must be noted that candidates were not required to name the conditions necessary for the process of germination.

Candidate's Response to Part (f) (iii)

(iii) Suggest ONE reason why there were less seeds germinating on Day 5 than on Day 4.

One reason is because there was not much left

(1 mark)

Examiner's Comments

The candidate provided a reasonable answer which was accepted.

General Comments

Many candidates were able to state that most of the seeds germinated on Day 4 however very few mentioned the genetic variability in the seeds.

Recommendations

Teachers and students need to take note of the following recommendations.

- Students need to be better prepared to deal with the representation/presentation of data, which is an important aspect of practical work. Candidates lost valuable marks due to a possible lack of exposure to drawing tables of results or interpreting graphical data.
- More time must be spent on the revision of the units and symbols used in the sciences.
- The need to produce neat, legible writing cannot be over-emphasized. Candidates continue to cross out written work, which is often-times correct, and replace it with nothing. In such cases candidates would receive no marks.
- Science educators should use relevant practical activities to enhance the delivery of the theoretical aspects of the syllabus. Both aspects are complementary and failure to acknowledge this can result in candidates having many misconceptions.

Question 2

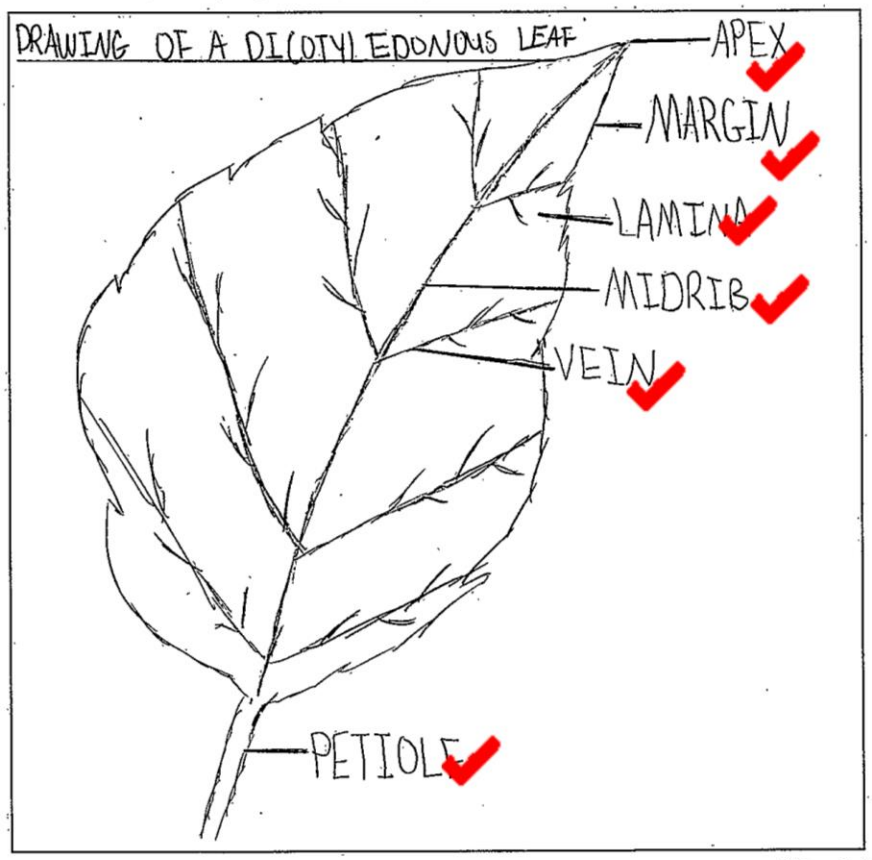
This question tested the following specific objectives from Section B (Life Processes and Disease) of the syllabus: 2.2, 2.3 and 2.4. Additionally, the profile skill areas assessed were Knowledge and Comprehension (KC), Use of Knowledge (UK) and Experimental Skills (XS). The question examined candidates' comprehension of photosynthesis, requiring them to identify leaf structures and to outline and explain the test for starch in leaves.

Using the materials and equipment listed below, the students in a Biology class designed an experiment to investigate the presence of starch in a green leaf from a dicotyledonous plant.

- Fresh green leaf
- Beaker
- Test tube
- Forceps
- Water
- Hot plate
- Alcohol
- Petri dish
- Iodine solution

Candidate's Response to Part (a)

(a) In the space provided below, draw and label the external features of a green dicotyledonous leaf that would likely be used in the experiment.



(5 marks)

Examiner's Comments

The candidate submitted a biological drawing with most labels accurately indicated. The drawing could have been improved if the candidate drew the diagram using continuous unbroken lines and reduced areas of lines overlapping.

General Comments

While several candidates were able to provide quality biological drawings, some submitted drawings which lacked proportion and/or were missing labels or were inaccurately labelled. It was noted that not many candidates were able to accurately provide all the expected labels for the drawing.

Candidate's Response to Part (b)

(b) Describe a suitable procedure to investigate the presence of starch in a green leaf. You must use ALL of the above materials and equipment in your procedure.

Procedure:

Step one - Add alcohol in the [redacted] beaker.

Step two - Place the beaker on top of the hot plate.

Step three - Use the forceps and place the leaf into the beaker.

Step four - After boiling the leaf, use the forceps to remove the leaf from the beaker.

Step five - Place the leaf [redacted] the petri dish.

Step six - Use the test tube and add a few drops of iodine solution. If starch is present, the leaf will turn into a dark-blue-black colour. If not, then starch is not present.

Examiner's Comments

The candidate was able to provide a mostly accurate procedure to investigate the presence of starch in a green leaf.

General Comments

Based on the submissions of many candidates, it was clear that many of them were not familiar with this experiment; therefore, such candidates were unable to provide detailed procedures.

The procedure could have been improved if some of the details below were included.

- Place the water in a beaker.
- Place the beaker on the hotplate and bring the water to a boil.

In addition, candidates should provide details related to the quantities of substances to be used and the duration of time for exposures. For example, dip the leaf in the boiling water for two minutes using the forceps. Candidates should use the language associated with writing procedures. They should state/note what they observe during the experiment.

Candidate's Response to Part (c)

(c) State ONE reason why alcohol is used in this experiment.

Alcohol is used in this experiment to help identify if starch is present.

(1 mark)

Examiner's Comments

The candidate did not indicate that alcohol is used to remove chlorophyll from the leaf.

General Comments

Common misconceptions were that the alcohol was used to

- remove starch from the leaf
- sanitize or kill bacteria
- remove any other substance that may react with the iodine solution.

Candidate's Response to Part (d)

(d) State TWO precautions which should be taken when doing the experiment described in (b).

Two precautions are: one, wear a lab coat in case of any spills and two, use the forceps to get the leaf within the hot beaker or else you'll get burn.

Examiner's Comments

The candidate was able to provide two precautions which should be taken when performing the experiment to investigate the presence of starch in a green leaf.

General Comments

While this candidate stated precautions for the experiment many others provided vague or nonspecific precautions with little or no linkage to the experiment outlined.

Candidate's Response to Part (e)

(e) Suggest a suitable conclusion that may be expected from this experiment.

Starch will be present from this experiment.

(2 marks)

Examiner's Comments

The candidate did not provide a suitable conclusion for the experiment.

General Comments

An example of a suitable conclusion would be *the blue-black colour change of the leaf when iodine solution was added shows that starch is present in the leaf.*

While some candidates could associate the blue-black with the presence of starch, they were unable to provide a conclusion.

Candidate's Response to Part (f) (i)

(f) The students in the biology class took a second green dicotyledenous leaf which was attached to a plant and covered it with foil for FOUR days. On the fifth day, the foil was removed and the procedure described in (a) was carried out using this leaf.

(i) State the expected observation at the end of the experiment.

No starch will be present in this leaf.

Examiner's Comments

The candidate did not provide an expected observation; however, he/she stated a result or conclusion.

General Comments

Expected observations included

- there will be no blue-black colour
- the colour of the iodine will remain reddish brown.

Some candidates made the following errors.

- Used vague statements such as 'the colour of the leaf changed' and 'there will be no reaction'
- Gave answers such as 'the leaf would give the same result'.

Candidate's Response to Part (f) (ii)

(ii) Explain the expected observation stated in (f) (i).

This is so, because foil will trap the heat, causing the plant to sweat. Due to this, there will be no starch present because of the lack of sunlight.

Examiner's Comments

The candidate did not clearly explain the expected observation stated in Part (f) (i).

General Comments

While most candidates were able to state that the leaf was covered by the foil and therefore no photosynthesis would occur or that there would be no starch present, many were not able to state any other information.

Responses like the one shown in the exemplar and many others could have been improved by providing detailed explanations such as the following.

> Due to the lack of photosynthesis, no glucose would be present. No glucose being produced means no starch would be present. Therefore, when the test using iodine is performed there would be no colour change/no blue-black colour would be observed.

Recommendations

Teachers and students should take note of the following recommendations.

- Teachers must use more practical activities as a part of their instruction. Doing so may help students to gain a better understanding of why certain steps are taken when conducting experiments and the role of the substances used in the experiments.
- Teachers should incorporate discussion sessions during which they pose questions to students which would require the students to review the application of some of the examination topics. Doing so may improve students' retention and understanding of core concepts. Such activities may therefore increase the ability of candidates to give full detailed responses instead of vague partial responses.

Question 3

This question tested the following sections and specific objectives from the syllabus.

- Section B — Life Processes and Disease: 3.3, 4.4 and 4.6
- Section C — Continuity and Variation: 2.9

Candidates were required to

- construct a bar graph from the tabular data
- analyse the graph drawn and state three trends from the graph
- draw a labelled diagram of a lymphocyte
- explain how the Covid-19 vaccine worked to prevent a person from becoming severely ill when they contracted the virus
- explain why it is necessary for humans to receive a continuous supply of oxygen
- draw a genetic diagram to show a cross between two persons who are carriers of the sickle cell trait
- show how the couple's child could have sickle cell anaemia.

Table 2 below shows the percentage of people in seven Caribbean countries who received at least one dose of the COVID-19 vaccine.

TABLE 2: PERCENTAGE OF PEOPLE IN SEVEN CARIBBEAN COUNTRIES WHO RECEIVED AT LEAST ONE DOSE OF THE COVID-19 VACCINE.

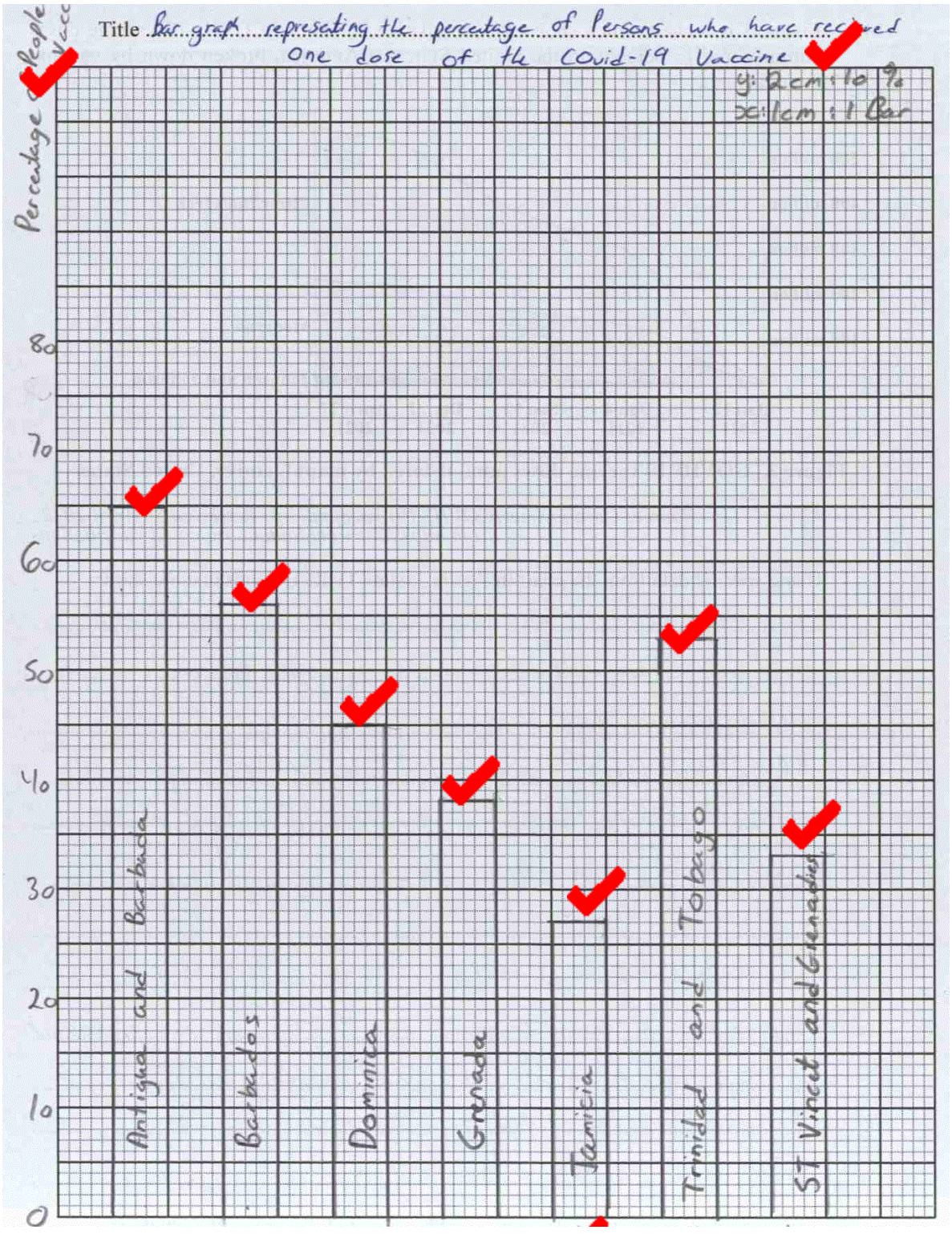
Country	Percentage of People Vaccinated
Antigua and Barbuda	65
Barbados	56
Dominica	45
Grenada	38
Jamaica	27
Trinidad and Tobago	53
St. Vincent and the Grenadines	33

Source: Coronavirus (COVID-19) Vaccinations. Retrieved 30 April 2022., from https://ourworldindata.org/covid-vaccinations

Candidate's Response to Part (a)

(a) On the grid provided **on page 15**, construct a bar graph using the data provided in Table 2. Provide a suitable title for the graph.

(5 marks)



Examiner's Comments

The candidate gave an appropriate title, labelled both axes, gave an appropriate scale and plotted all points correctly.

General Comments

Most candidates were able to construct a bar graph and give the graph an appropriate title. Such candidates gained full marks. However, some candidates did not use an appropriate scale and so it was difficult for them to plot the percentages accurately. Marks were awarded for providing the following.

- A title provided
- Two labelled axes
- An appropriate scale
- Accurate plots

Candidate's Response to Part (b)

(b) Figure 3 is a chart which shows the cumulative number of COVID-19 vaccine doses administered to persons in the United States of America, broken down by vaccine manufacturer.

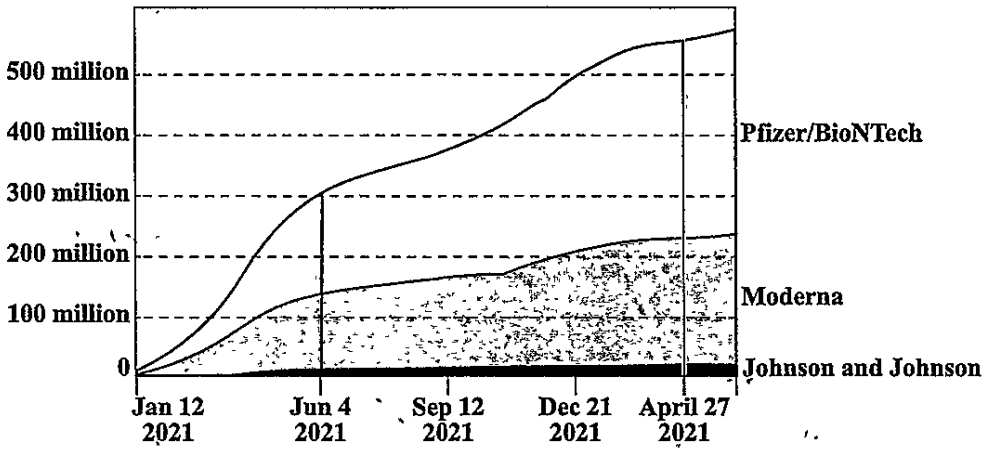


Figure 3. COVID-19 vaccine doses administered by manufacturer, United States

Source: Coronavirus (COVID-19) Vaccinations. Retrieved 30 April 2022., from https://ourworldindata.org/covid-vaccinations

Using specific data from the chart in Figure 3, state THREE trends that are shown.

- As time increased an increased for the number of vaccination for all manufactures with April 2021 being the greatest time for vaccinations ✓
- Pfizer/BioNTech showed/displayed the greatest increase of 300 million in June 2021 to & more than 500 million in April 2021 ✓
- It was observed during the months of September to December of 2021, Moderna observed a ~~fall~~ decrease in number of vaccinations to roughly 175 million but later increased over the coming months

BOD

Examiner's Comments

The candidate highlighted two correct trends based on the chart. With respect to the third trend, the candidate was given the benefit of the doubt and awarded a mark for the answer provided. There was a typographical error on the chart provided; The last date should have been April 27, 2021. However, candidates were not negatively impacted by this error.

General Comments

Most candidates were able to identify three trends and score three marks. However, some candidates did not understand what the term *trend* meant. Some candidates stated that the numbers represented 'the vaccines manufactured' instead of those administered. The following are some of the trends candidates were expected to mention.

- There has been a sharp increase in the number of Covid-19 doses administered to persons in the United States [same for all three manufacturers].
- The increase in doses was noted between January 12, 2021 and April 27, 2022.
- There was an increase from zero to approximately 550 million people being vaccinated.
- Pfizer was the most popular vaccine used by persons.
- The uptake of the Johnson and Johnson vaccine was minimal during the period Jan 12, 2021, and April 27, 2022.

Candidate's Response to Part (c)

(c) Draw a labelled diagram of a lymphocyte.

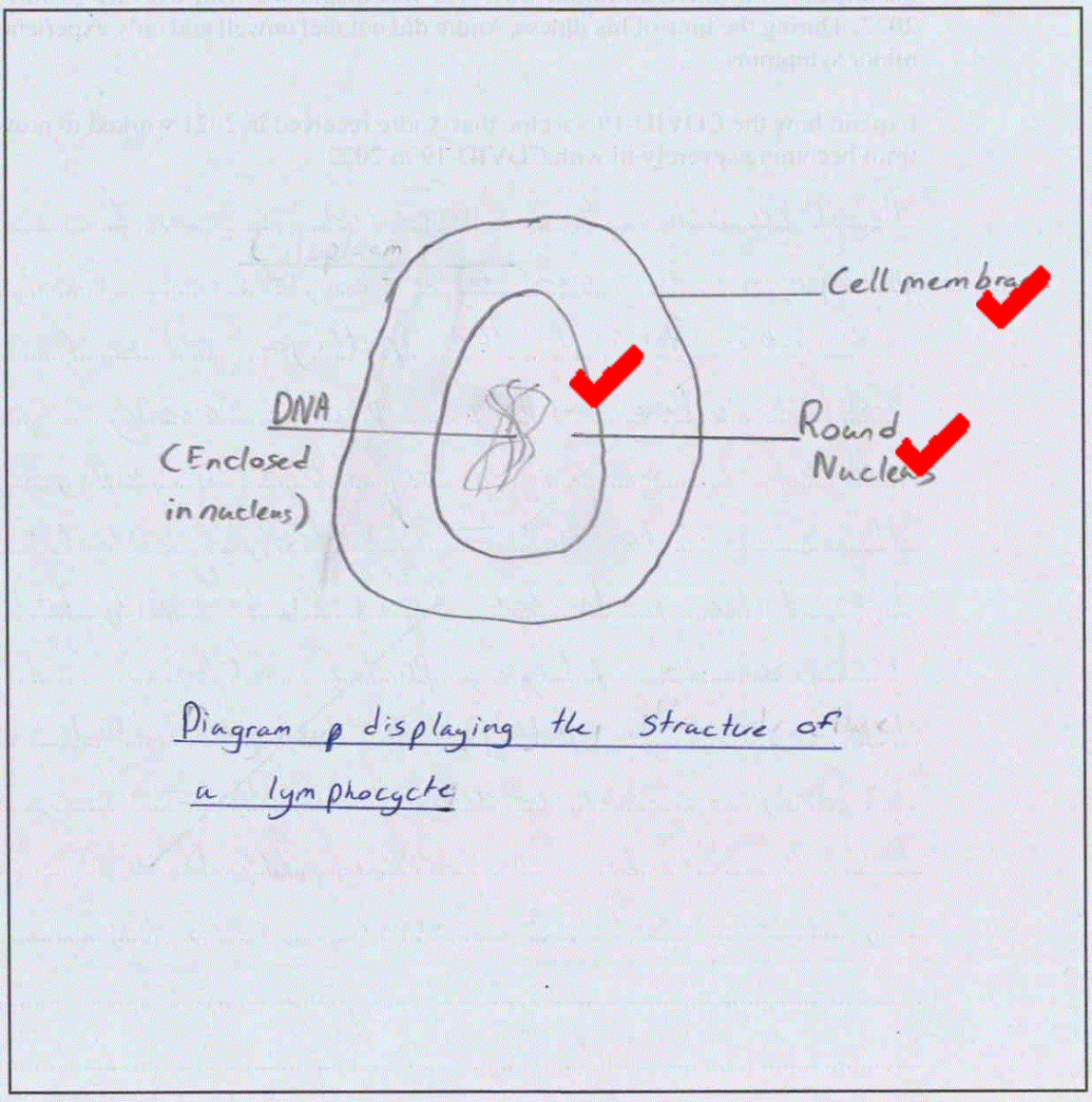


Diagram p displaying the structure of a lymphocyte

(3 marks)

Examiner's Comments

The candidate was awarded full marks for the drawing.

General Comments

- Some candidates were able to gain full marks because they provided an excellent drawing.
- From the submissions, it was apparent that some candidates were not familiar with lymphocyte drawings/images.
- Some candidates labelled their diagram using the term C*ell wall*. This was an incorrect label.

Candidate's Response to Part (d)

(d) Andre received the NOVAX® COVID-19 vaccine in April 2021. The vaccine had been manufactured in the **traditional** way. He was diagnosed with COVID-19 in February 2022. During the time of his illness, Andre did not feel unwell and only experienced very minor symptoms.

Explain how the COVID-19 vaccine that Andre received in 2021 worked to prevent him from becoming severely ill with COVID-19 in 2022.

As Andre has gained immunity the traditional way, his body contains memory lymphocytes to the virus. In the case where he was later infected with the virus, his body was able to produce sufficient antibodies to reduce the adverse effects of the virus. This left him only to only face very minor Symptoms

Examiner's Comments

The candidate gained marks for referring to the main points. These points are fully explained in the General Comments section.

General Comments

It was expected that candidates would include all the following points in their explanation.

- A mild form of the COVID-19 virus (antigen) was injected/a weakened or mild form of the pathogen was injected.
- Andre's lymphocytes produce antibodies (and memory cells).
- Memory cells recognize the COVID-19 antigens if they enter the body again.
- Memory cells quickly divide to form more lymphocytes like themselves.
- When the pathogen re-entered his body in 2022, the body was able to fight off the infection
- This occurred because large amounts of the antibody were produced
- When exposed to COVID-19 in 2022, Andre had developed immunity to the virus and therefore did not get severely ill.

Candidates were awarded the marks if reference was made to the four main points which are given below.

- Vaccination with weak form of virus
- Antibody production
- Re-infection
- Response to re-infection

Candidate's Response to Part (e)

(e) Some persons with COVID-19 experienced shortness of breath and this made it very difficult for them to breathe. Explain why it is necessary for human beings to receive a continuous supply of oxygen.

The presence of oxygen allows for cell within the body to respirate and metabollate as energy is release allowing the body to do its work

Examiner's Comments

The candidate received full marks for this response.

General Comments

Candidates who wrote *a continuous supply of oxygen is needed for aerobic respiration and if this is not present, the body will not be able to release enough energy from food* received full marks.

Candidates received the benefit of the doubt and were awarded a mark for stating that the body/brain/organs would die without oxygen.

Candidate's Response to Part (f)

(f) Andre and his wife are both carriers of the sickle cell trait. They have a child who has sickle cell anaemia.

With the use of a genetic diagram, show the cross between Andre and his wife that results in the child having sickle cell anaemia.

N - Normal

S - Sicked Cell Anemia ✓

Parental genotypes NS × NS ✓

offspring genotype

	N	S
N	NN	NS ✓
S	NS	SS ✓

offspring phenotype NS : NN : SS

2 : 1 : 1

50% : 25% : 25%

As both parents are ~~carrier~~ carriers of the trait, ~~they~~ their genotypes are of NS. when ~~those~~ these gametes exchange, the combination of the gametes leaves a 25% ✓ possibility of offspring with Sicked Cell anemia

(5 marks)

Examiner's Comments

The candidate gained full marks for identifying the alleles and the parental genotypes, showing the possible crosses between Andre and his wife, and identifying the cross that would cause the child to have sickle cell anaemia.

General Comments

Some candidates gave excellent crosses and clearly stated the definition, genotypes and percentages. However, many candidates did not define the alleles. Some of them used X and Y even though the trait was not sex-linked.

In general, candidates received marks for the cross once it was accurate, as this was one of the skills tested.

Recommendations

Many candidates lost valuable marks when plotting graphs because they used an inappropriate scale. Additionally, candidates should be reminded that all graphs should have a title and the axes should be labelled.

When candidates are asked to complete genetic diagrams in the examination, many of them perform poorly. Therefore, teachers should consider giving students practical exercises so that they have more opportunities to practice.