CARIBBEAN EXAMINATIONS COUNCIL

CSEC® BIOLOGY

Subject Report with Exemplars

May/June 2023

CARIBBEAN EXAMINATIONS COUNCIL

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

MAY/JUNE 2023

BIOLOGY
GENERAL PROFICIENCY

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INTRODUCTION

This guide is based on candidate responses to the 2023 May/June examinations in CSEC Biology. Examinations are offered in two sittings each year — January and May/June.

Overall, the performance in 2023 May/June was marginally better than it was in the 2022 May/June sitting. This year 73.97 per cent of candidates obtained Grades I–III compared to 78.14 per cent in 2022 and 74.08 per cent in 2021.

With regards to performance by paper, 84.10 per cent of candidates obtained Grades I–III on Paper 01 in 2023, compared to 86.85 per cent in 2022 and 81.94 in 2021. Whereas for Paper 02, 55.81 per cent of candidates obtained Grades I–III in 2023 compared to 66.66 per cent in 2022 and 55.18 per cent in 2021. For Paper 03 (SBA), 85.93 per cent of candidates obtained Grades I–III in 2023, compared to 85.91 per cent in 2022 and 86.39 in 2021.

For Profile 1 (KC), 72.97 per cent of candidates obtained Grades A–C compared to 78.62 per cent in 2022, and 68.68 in 2021. For Profile 2 (UK),47.50 per cent of candidates obtained Grade A–C compared to 50.77 per cent in 2022, and 47.29 in 2021. For Profile 3, 95.88 per cent of candidates obtained Grades A–C compared to 96.74 per cent in 2022, and 97.41 in 2021.

PAPER 01 – MULTIPLE CHOICE

Overall, candidates performed fairly well in Paper 01. This year, the mean score for Paper 01 was 40.68 compared to the mean scores of 42.10 in 2022 and 40.63 in 2021.

PAPER 02 – STRUCTURED/EXTENDED ESSAY

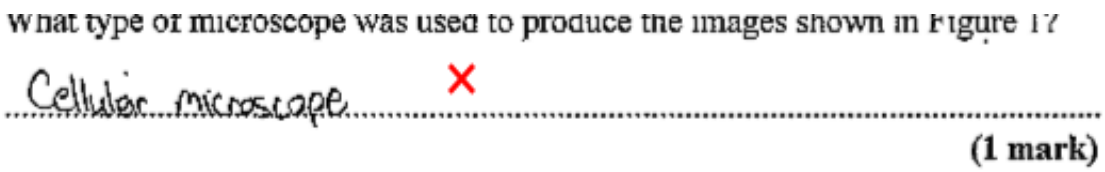
This year, the mean score for Paper 02 was 41.29 compared to the mean score of 46.08 in 2022 and 44.25 in 2021.

Question 1

This question tested Specific Objectives B 1.1, 1.2 and 1.3. The question required candidates to be able to compare the structure of the generalized plant and animal cells, and selected microbes; distinguish between cell wall and cell membrane, and mitochondrion and chloroplast; and relate the structure of organelles to their functions.

For Part (a) (i), candidates were given micrographs of an animal cell and a plant cell. Candidates were required to say what type of microscope was used to produce the images shown in the figure. The expected answer was *the transmission electron microscope.* Candidates who simply wrote *electron microscope* were awarded the mark.

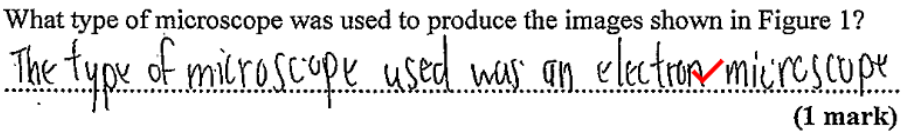
Candidate's Response to Part (a) (i) – Sample 1



Examiner's Comments

This candidate was given zero for an incorrect answer.

Candidate's Response to Part (a) (i) – Sample 2



Examiner's Comments

The candidate gave the correct answer and was awarded the mark.

Many candidates seemed to be unfamiliar with the types of microscopes and gave responses such as 'telescope' and 'periscope' or described the microscope as 'an electric microscope'. These responses were not credited.

Part (a) (ii) required candidates to draw a large, clearly labelled diagram of one plant cell from the micrograph in the figure given in Part (a) (i).

Most candidates were able to earn at least four marks for this question. Generally, candidates were aware of basic biology drawing skills and most of them presented the drawing of a typical plant cell. However, plant cells are not always typical; a cell may have the characteristic structures present but the size, shape and number of organelles may differ based on the specialization.

Most candidates adhered to the rule which states that label lines must not intersect. However, skills such as no shading, neat lines, labelling, title placement and the calculation of magnification need to be emphasized. A large percentage of candidates did not include magnification and did not draw the shape of the cell correctly; hence, those marks were forfeited.

Some candidates attempted to draw the actual cell from the micrograph. Some drew and labelled plant cells from memory. A few candidates failed to follow the instructions by drawing multiple cells and organelles that were not seen in the micrograph. Some candidates also struggled to label cell structures accurately. The experimental skill of calculation of the magnification of the drawing seems to be lacking across most of the territories.

Most candidates, therefore, failed to receive the mark for magnification. The skill of correctly calculating the magnification as well as stating it correctly needs to be re-taught or reinforced. Students also need to be reminded that shading is not allowed; Stippling or cross-hatching is, however, acceptable.

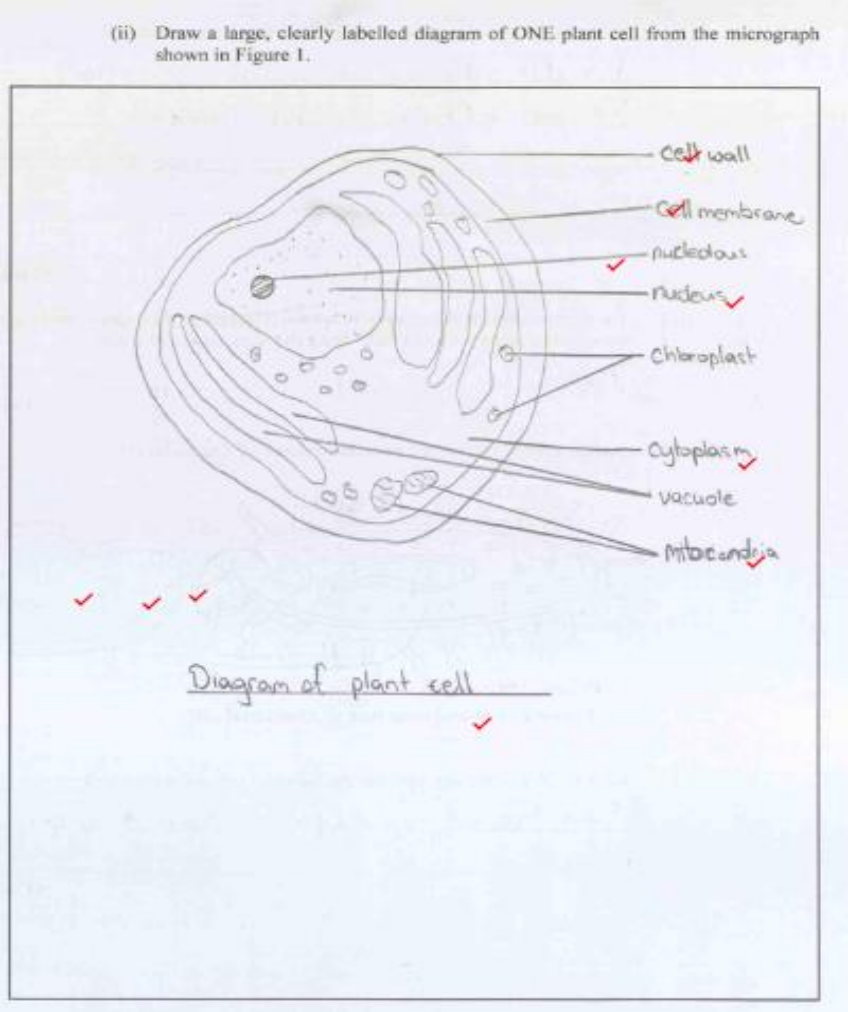
Marks were awarded as follows.

- Correct magnification (1)
- Clean continuous lines with no shading (1)
- Correct shape (1)
- Title (1)
- Labelling lines that are not intersecting (1)
- Labelling (4)
    - Cell wall
    - Cell membrane
    - Nucleus
    - Nucleolus
    - Cytoplasm
    - Vacuole
    - Chloroplast

- Mitochondria/mitochondrion
- Starch grain(s)

The list of cell organelles above represents those that were visible on the micrograph which was shown in the figure. Hence, candidates were not awarded marks for any cell organelles that are not listed above.

Candidate's Response to Part (a) (ii) – Sample 1

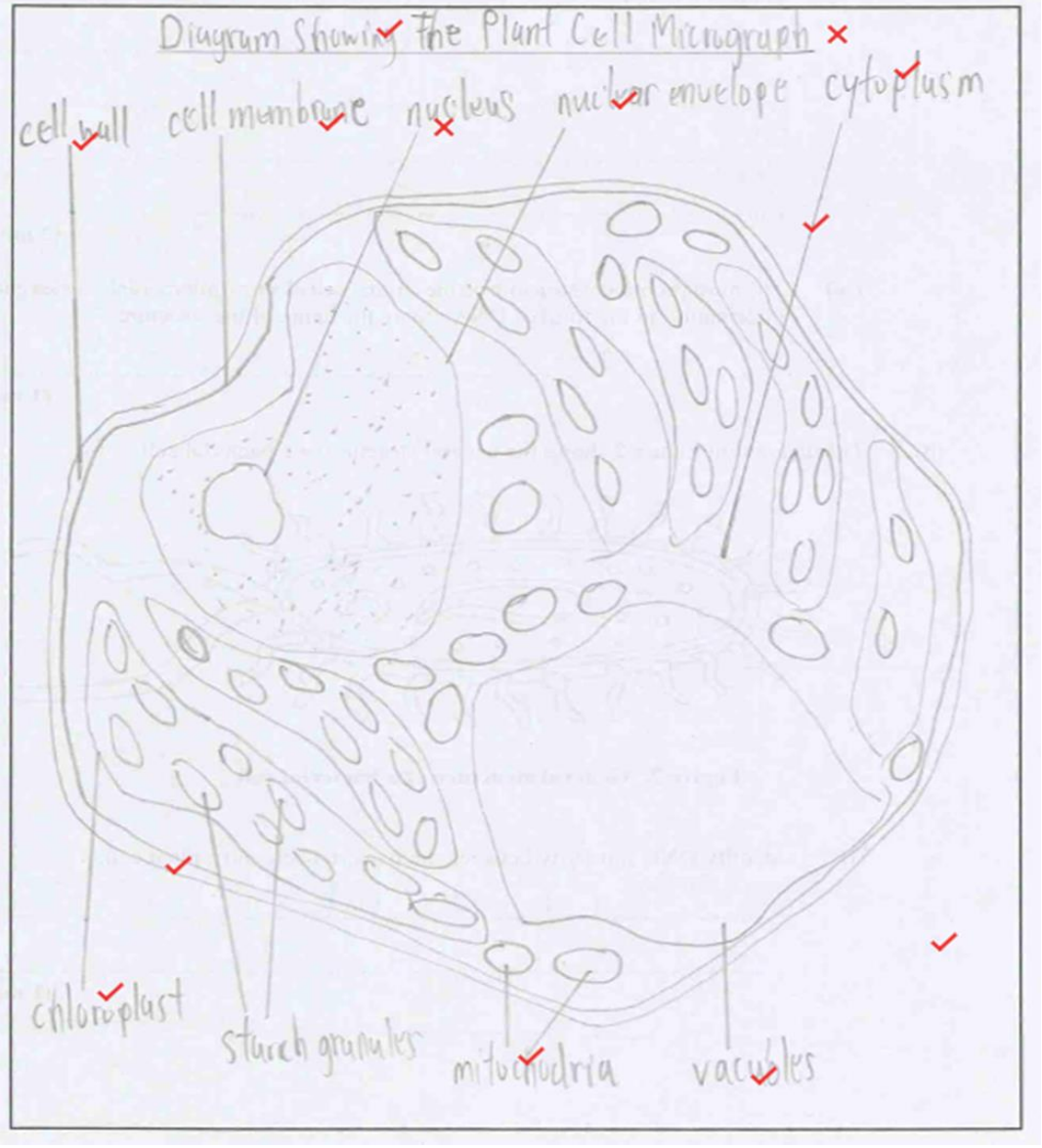


Examiner's Comments

The candidate earned seven out of nine marks for this diagram. One mark was deducted for not stating the magnification. One mark was also deducted for incorrectly labelling the vacuole and chloroplast.

Candidate's Response to Part (a) (ii) – Sample 2

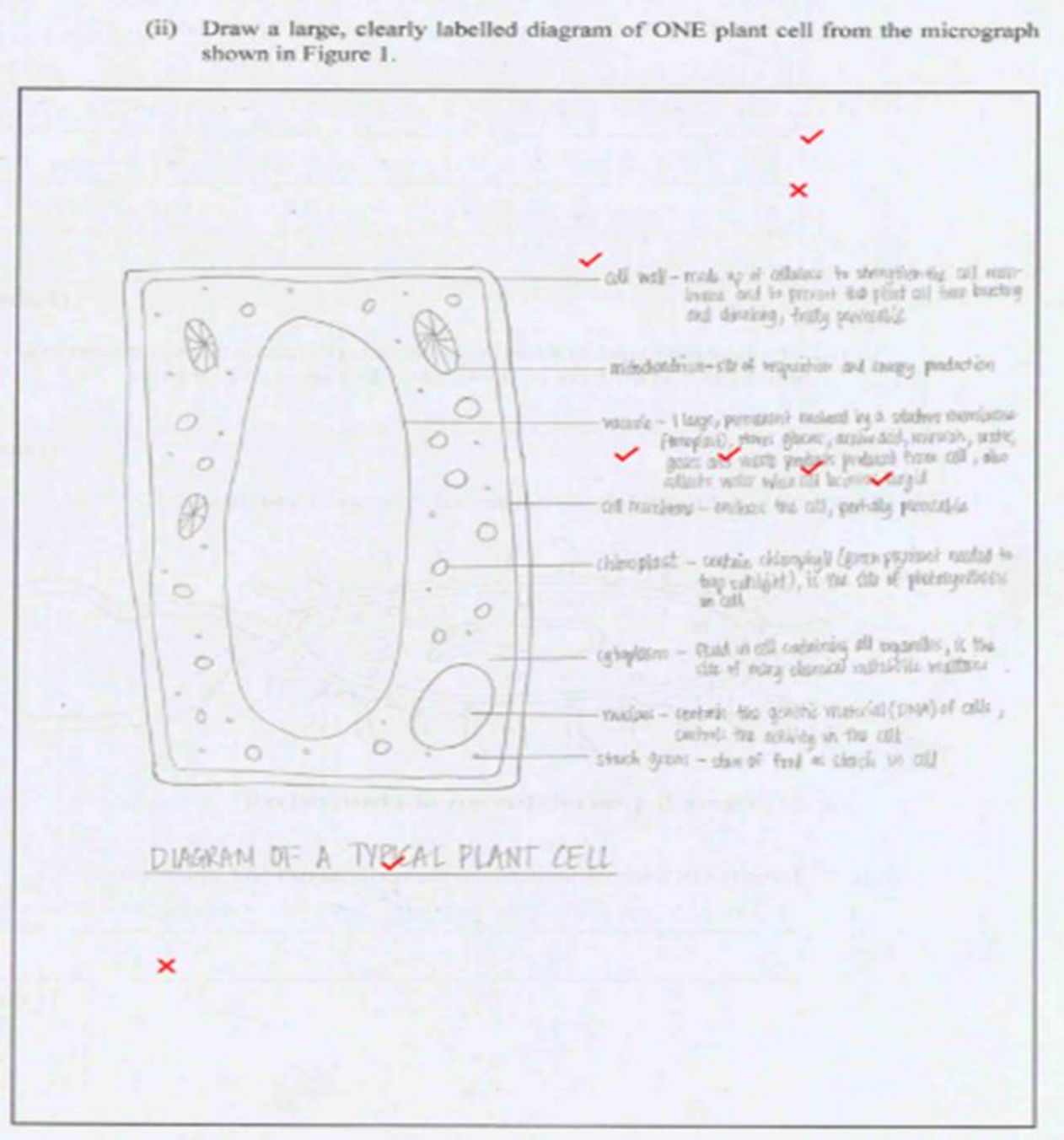
(ii) Draw a large, clearly labelled diagram of ONE plant cell from the micrograph shown in Figure 1.



Examiner's Comments

This candidate was awarded marks for the title, the drawing, and seven or more correct labels but lost the mark for magnification. The candidate received eight out of nine marks.

Candidate's Response to Part (a) (ii) – Sample 3

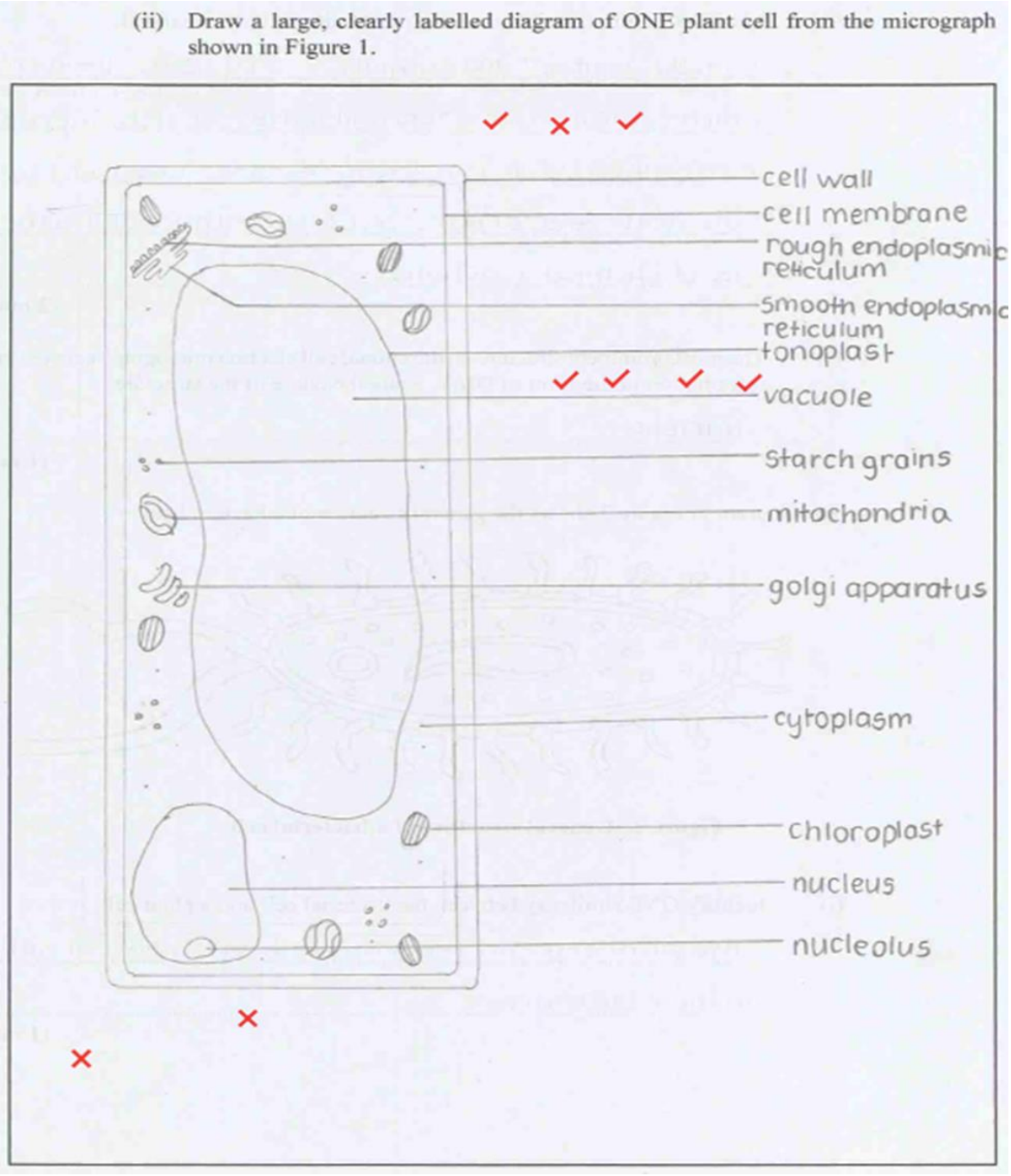


Examiner's Comments

The candidate scored seven out of nine marks. Marks were lost for magnification and shape of the plant cell. There is a misconception that all plant cells are rectangular. The one in the electron micrograph given was rounded.

Candidate's Response to Part (a) (ii) – Sample 4

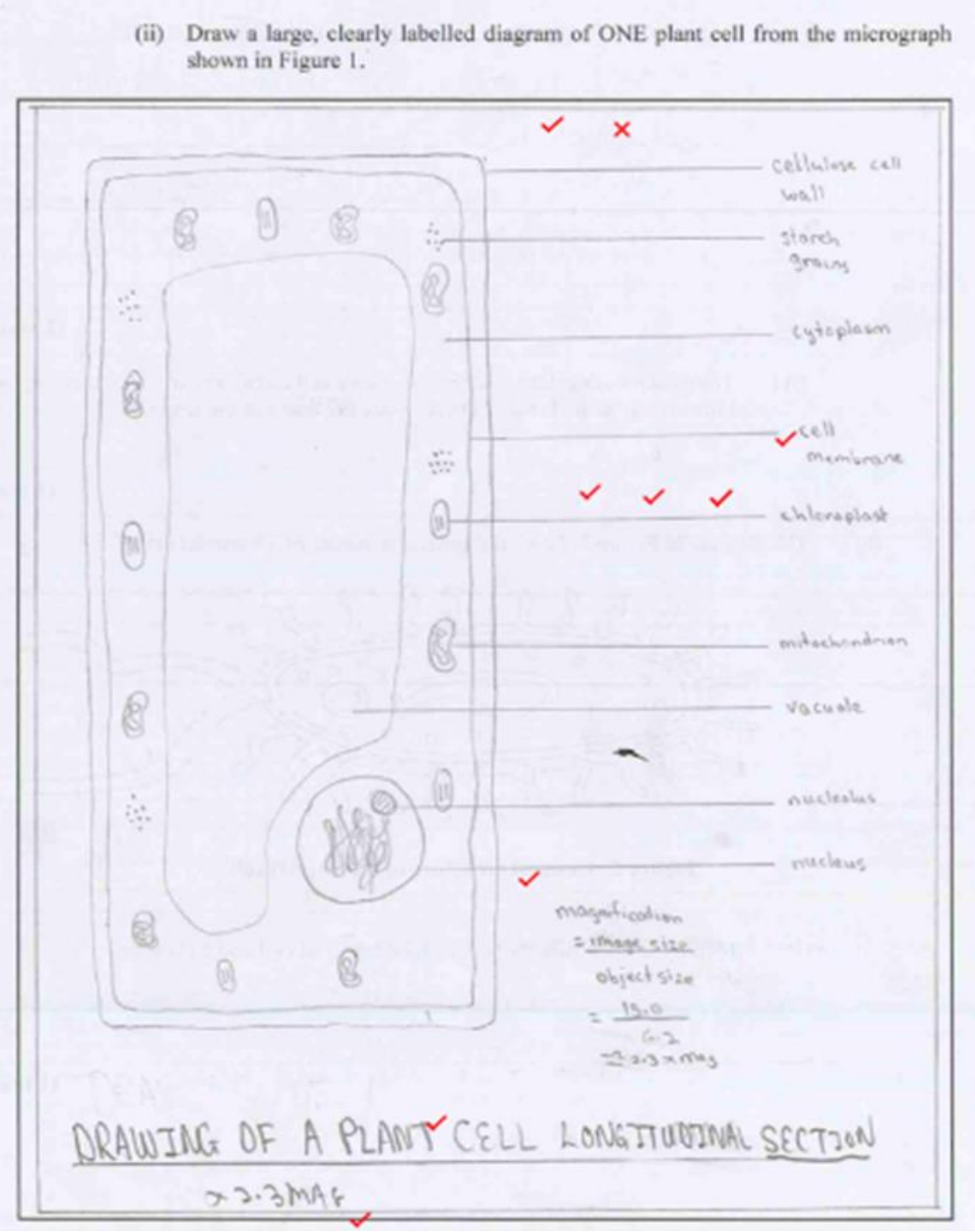
(ii) Draw a large, clearly labelled diagram of ONE plant cell from the micrograph shown in Figure 1.



Examiner's Comments

This diagram was beautifully drawn and labelled but the candidate scored six out of nine because of the inaccurate shape, and the absence of a title and magnification.

Candidate's Response to Part (a) (ii) – Sample 5



Examiner's Comments

The candidate lost one mark because of the incorrect shape of the diagram, receiving eight out of nine marks.

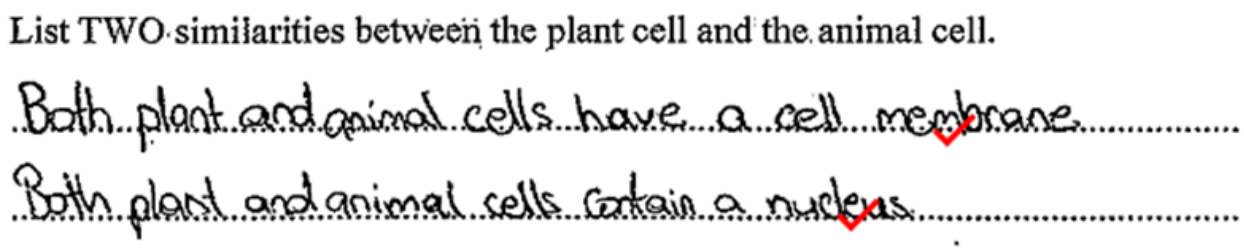
Common misconceptions in this question included the following.

- The nucleus is in the vacuole.
- The cell membrane lies outside the cell wall.
- Chlorophyll lies outside the chloroplast.

Part (a) (iii) required candidates to list two similarities between the plant cell and the animal cell. Most candidates responded with at least one correct similarity.

The following samples are given to highlight various ways in which correct answers were expressed.

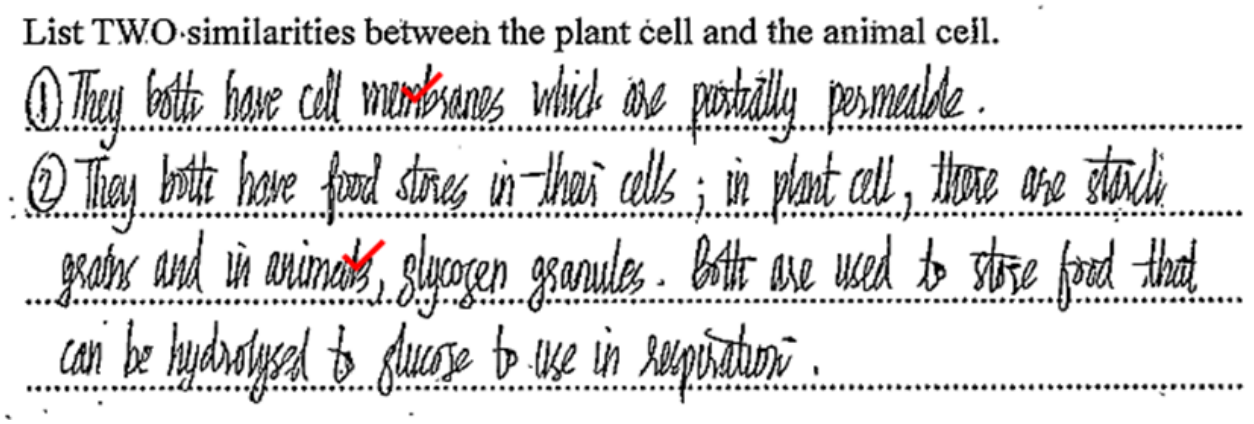
Candidate's Response to Part (a) (iii) – Sample 1



Examiner's Comments

This candidate was awarded full marks for the response given.

Candidate's Response to Part (a) (iii) – Sample 2



Examiner's Comments

This candidate's response was worth full marks.

Candidate's Response to Part (a) (iii) – Sample 3

List TWO similarities between the plant cell and the animal cell.

Both the plant cell and animal cell contains a cell membrane (partially permeable) which controls what enters and leaves the cells. They also both contain cytoplasm, a jelly-like substance made up of 60% water ~~and~~, 20% dissolved substances and is the site of chemical reactions.

Examiner's Comments

This candidate was awarded full marks for the response.

Candidate's Response to Part (a) (iii) – Sample 4

List TWO similarities between the plant cell and the animal cell.

(1) Both plant cells and animal cells contain cell membranes.

(2) Both types of cells contain mitochondria.

(3) Both types of cells contain cytoplasm.

Examiner's Comments

For this response, the candidate was awarded full marks.

Part (a) (iv) stated that the most prominent structure on the animal cell electron micrograph carries genetic information in the form of DNA. The name of the structure was required. Expected responses were *nucleus* or *chromatin.* The response 'chromosomes' was not accepted because chromosomes are not visible on the micrograph. Most candidates were able to receive the mark.

Candidate's Response to Part (a) (iv) – Sample 1

The most prominent structure on the animal cell electron micrograph carries genetic information in the form of DNA. State the name of the structure.

Nucleus ✓

(1 mark)

Candidate's Response to Part (a) (iv) – Sample 2

The most prominent structure on the animal cell electron micrograph carries genetic information in the form of DNA. State the name of the structure.

The name of this structure is the nucleus ✓

(1 mark)

Candidate's Response to Part (a) (iv) – Sample 3

The most prominent structure on the animal cell electron micrograph carries genetic information in the form of DNA. State the name of the structure.

The nucleus ✓ is the most prominent structure.

(1 mark)

Examiner's Comments

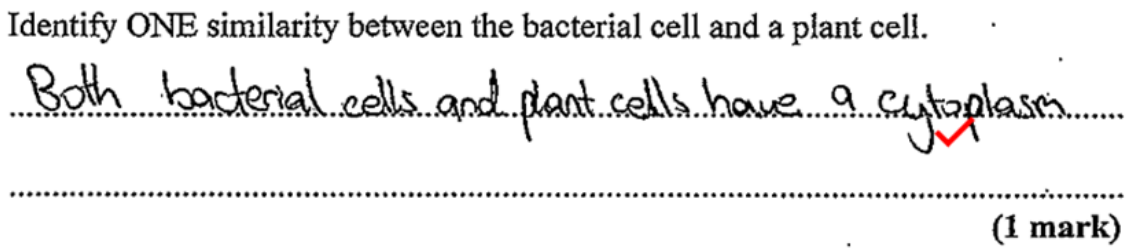
In the samples above which show responses for Part (a) (iv), the candidates all gave correct responses.

For Part (b) (i), a diagram of the generalized structure of a bacterial cell was given. Candidates were then asked to identify one similarity between the bacterial cell and a plant cell. The following points were credited.

- Both have cytoplasm.
- Both have a cell wall.
- Both have a cell membrane.
- Both have DNA.
- Both have a fixed shape/definite shape.
- Both have ribosomes.

A few candidates seemed to misunderstand the identification of similarities between the plant cell and the bacterial cell, but most candidates answered correctly.

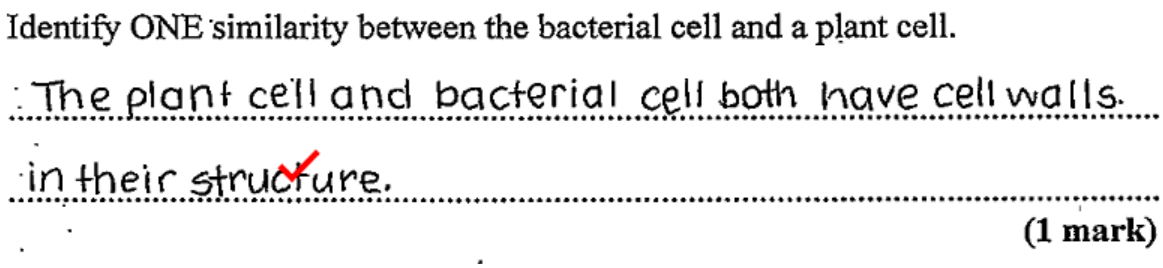
Candidate's Response to Part (b) (i) – Sample 1


Identify ONE similarity between the bacterial cell and a plant cell.

Both bacterial cells and plant cells have a cytoplasm

(1 mark)

Candidate's Response to Part (b) (i) – Sample 2


Identify ONE similarity between the bacterial cell and a plant cell.

The plant cell and bacterial cell both have cell walls.

in their structure.

(1 mark)

Examiner's Comments

The two candidates' responses shown in the samples above were correct.

For Part (b) (ii), it was noted that the structures of the bacterial cell are especially suited for the role of infecting other organisms. Candidates were asked to complete a table to explain how each structure helps the bacterium to infect organisms. An example was provided on the table. Some of the expected answers were as follows.

Name of structure*: Slime capsule*

How the structure helps the bacterium to infect other organisms

- Protects the bacterial cell from antibiotics/chemicals (1 mark) so the bacteria continue to grow and multiply in the organism (1 mark)
- Protects the bacterial cell from drying out (1 mark) so the bacteria survive (1 mark)
- Allows bacteria to stick to smooth medical devices, for example, catheters (1 mark) so bacteria survive/are not washed away (1 mark)
- Protects against phagocytes (1 mark) so the bacteria survive (1 mark)
- Slime offers less resistance/lubricates the bacterial cell (1 mark) so the bacteria can move freely (1 mark)
- Slime capsule contains antigens (1 mark), helping the bacteria to invade cells (1 mark)
- Slime capsule functions as a conduit (1 mark), allowing nutrients and enzymes in and out of the bacterial cell (1 mark)

Name of structure: *Flagellum*

How the structure helps the bacterium to infect other organisms

- Increases the motility of the bacterium (1 mark) so it can get easy access to cells and within cells (1 mark)
- Avoids unfavourable environments/moves to favourable environments (1 mark) so the bacteria survive (1 mark)
- Helps to form biofilms (1 mark) so bacteria survive (1 mark)
- Acts as a sensory organ to detect temperature changes (1 mark) so bacteria are protected from extreme temperatures (1 mark)

Name of structure: *Cell wall*

How the structure helps the bacterium to infect other organisms

- Prevents lysis of the cell by osmosis (1 mark) so bacteria survive (1 mark)
- Makes the cell rigid/maintains the cell's shape/structural support (1 mark) so it is not easily damaged (1 mark)
- Protects the cell interior (1 mark) so the bacteria survive and reproduce (1 mark)
- Acts like a barrier (1 mark), preventing the cell from bursting when it takes up water (1 mark)
- Serves as a barrier (1 mark) to prevent phagocytosis/attack by white blood cells (1 mark)

Many candidates stated the function of the structure correctly but did not relate it to the bacterium infecting organisms. Candidates need to pay special attention to the marks allocated to questions. In this instance, three structures for six marks should have indicated to candidates that two points must be made about each structure with respect to the bacterium's capacity to infect other organisms or its viability.

Common misconceptions included the following.

- That the flagellum being referred to was from sperm
- That the slime capsule carries DNA
- That the cell wall belonged to a plant cell

Candidate's Response to Part (b) (ii) – Sample 1

(ii) The structures of the bacterial cell are especially suited for its role in infecting other organisms. Table 1 lists four of these structures.

Complete Table 1 by explaining how EACH structure helps the bacterium to infect organisms. **An example has been provided for you.**

TABLE 1: STRUCTURES IN THE BACTERIUM

Name of Structure	Benefit to Bacterium
Pili or fimbriae	• Protect bacterial cell from being eaten by phagocytes so the bacteria continue to survive and multiply
Flagellum	• Aids bacteria with mobility, allowing it to across and through surfaces in order to infect organisms.
Slime capsule	• Stores nutrients and minerals essential for the cell's survival and eventual reproduction
Cell wall	• Protects cell from bursting if too much is consumed when it becomes turgid, allowing it to survive & multiply

Examiner's Comments

This candidate scored all the marks allotted.

Candidate's Response to Part (b) (ii) – Sample 2

Complete Table 1 by explaining how EACH structure helps the bacterium to infect organisms. **An example has been provided for you.**

TABLE 1: STRUCTURES IN THE BACTERIUM

Name of Structure	Benefit to Bacterium
Pili or fimbriae	• Protect bacterial cell from being eaten by phagocytes so the bacteria continue to survive and multiply
Flagellum	• helps/aids in the movement of the bacteria which helps it move around the organism and infect cells
Slime capsule	• this is the external boundary around the bacteria. which holds all of the structures which aid in the continuity and survival of the bacteria
Cell wall	• this structure supports the shape of the bacteria and prevents the bacteria from bursting incase a lot of water diffuses into it which allows the bacteria to survive and continue infecting the organism

Examiner's Comments

This candidate scored four marks because the response given regarding for the benefit of the slime capsule to the bacterium was vague. Refer to the previous list of expected responses (page 17) for examples of more thorough responses.

Candidate's Response to Part (b) (ii) – Sample 3

(ii) The structures of the bacterial cell are especially suited for its role in infecting other organisms. Table 1 lists four of these structures.

Complete Table 1 by explaining how EACH structure helps the bacterium to infect organisms. **An example has been provided for you.**

TABLE 1: STRUCTURES IN THE BACTERIUM

Name of Structure	Benefit to Bacterium
Pili or fimbriae	• Protect bacterial cell from being eaten by phagocytes so the bacteria continue to survive and multiply
Flagellum	• Allows the bacterial cell to move inside the host and feed and multiply infecting large areas of the organism.
Slime capsule	• Lubricates the bacterial cell and aids in movement around the host organism.
Cell wall	• Strengthens the bacterial cell as it moves through the host, preventing the bursting and shrinking of the cell and hence, better able to survive.

Examiner's Comments

This candidate scored full marks.

Candidate's Response to Part (b) (ii) – Sample 4

(ii) The structures of the bacterial cell are especially suited for its role in infecting other organisms. Table 1 lists four of these structures.

Complete Table 1 by explaining how EACH structure helps the bacterium to infect organisms. **An example has been provided for you.**

TABLE 1: STRUCTURES IN THE BACTERIUM

Name of Structure	Benefit to Bacterium
Pili or fimbriae	• Protect bacterial cell from being eaten by phagocytes so the bacteria continue to survive and multiply
Flagellum	• Flagellum allows for the movement of the bacteria on surfaces, enabling it to continue its survival and multiply, giving it the ability to escape ~~lymp~~ phagocytes
Slime capsule	• Allows the bacteria to be able to move around easier, protects internal structures
Cell wall	• Allows the bacteria to survive when in water, preventing it from bursting

Examiner's Comments

This candidate scored full marks.

Candidate's Response to Part (b) (ii) – Sample 5

Cell wall	They help the bacterium keep its shape to survive.

Examiner's Comments

This candidate scored one out of the two marks for the response regarding the structure of the cell wall. One mark was lost because the benefit of the cell wall was not fully explained. The "keeping of its shape" implies structural support but the second part of the answer, 'to survive' was too vague. Instead, the candidate could have stated "so it is not easily damaged".

For Part (c) (i), it was stated that human beings are multicellular and are made up of a large variety of cells. A table was provided, and candidates were required to complete the table (Differences in Cell Structure) by distinguishing between the following cells.

- Red blood cells and skin cells
- Nerve cells and Skin cells

It seems that candidates need more practice differentiating between structural differences and functional differences. For example, many candidates gave distinguishing functions of red blood cells and nerves instead of providing structural differences. Some candidates were unable to earn more than two marks in this question. Most candidates seemed to be unaware of the shapes of skin cells and nerve cells. However, the shape of the red blood cell was well known.

Candidate's Response to Part (c) (i) – Sample 1

Human beings are multicellular and are made up of a large variety of cells.

(i) Complete Table 2 by distinguishing between the following cells:

- Red blood cells
- Skin cells
- Nerve cells

TABLE 2: DIFFERENCES IN CELL STRUCTURE

Cell	Difference in Structure
Red blood cells and skin cells	Red blood cells contain haemoglobin and are biconcave, whereas skin cells don't contain haemoglobin but instead, melanin, and is not biconcave in shape.
Skin cells and nerve cells	Nerve cells ~~do~~ contain structures such as dendrites, axon terminals, and axons, whereas skin cells do not, and are much shorter than nerve cells.

Examiner's Comments

This candidate scored all four marks for providing a complete answer.

Candidate's Response to Part (c) (i) – Sample 2

Human beings are multicellular and are made up of a large variety of cells.

(i) Complete Table 2 by distinguishing between the following cells:

- Red blood cells
- Skin cells
- Nerve cells

TABLE 2: DIFFERENCES IN CELL STRUCTURE

Cell	Difference in Structure
Red blood cells and skin cells	Red blood cells have a biconcave structure and no ~~cells~~ nucleus while skin cells don't have a biconcave structure and have a nucleus
Skin cells and nerve cells	Nerve cells have extensions such as dendrites and the axon which helps with the transmission of impulses while skin cells don't have extensions and have a ~~circular~~ spherical shape

Examiner's Comments

This candidate scored full marks despite stating that skin cells having a 'spherical' shape. This incorrect statement was ignored since one correct difference had already been given.

Candidate's Response to Part (c) (i) – Sample 3

Human beings are multicellular and are made up of a large variety of cells.

(i) Complete Table 2 by distinguishing between the following cells:

- Red blood cells
- Skin cells
- Nerve cells

TABLE 2: DIFFERENCES IN CELL STRUCTURE

Cell	Difference in Structure
Red blood cells and skin cells	Red blood cells are biconcave discs containing haemoglobin and cytoplasm. Skin cells are constituents of dermal and epidermal tissue of the skin, made from epithelium cells.
Skin cells and nerve cells	Skin cells make up dermal and epidermal tissue of skin. Nerve cells have a body cell, axon and dendrites, that make up the neurones of body. and synapses.

Examiner's Comments

This candidate did not provide a difference in structure for skin cells; hence, only two marks were awarded. A suitable answer is *skin cells contain keratin/collagen* or *skin cells are not biconcave in shape*.

Candidate's Response to Part (c) (i) – Sample 4

Human beings are multicellular and are made up of a large variety of cells.

(i) Complete Table 2 by distinguishing between the following cells:

- Red blood cells
- Skin cells
- Nerve cells

TABLE 2: DIFFERENCES IN CELL STRUCTURE

Cell	Difference in Structure
Red blood cells and skin cells	Red blood cells have a biconcave disc shape and contains no nucleus while skin cells do contain nuclei and other organelles.
Skin cells and nerve cells	Nerve cells contain dendrites, axons, myelin sheaths, Schwann cell, node of Ranvier ~~while skin cells~~ to transmit messages while skin cells do not.

Examiner's Comments

This was a clearly written, accurate response for which the candidate scored four out of four marks.

In Part (c) (ii), candidates were asked to name one feature that would enable a scientist to distinguish a spherical bacterial cell from an animal cell when viewed under a microscope. This part of the question was well done as most candidates were aware of differences between bacterial and animal cells. Some candidates lost the mark because they did not specify that the specific (named) organelle was found in the animal cell only. For example, they simply stated 'nucleus' without identifying to which type of cell the nucleus belonged.

Overall, most candidates were able to earn some marks for this question. Candidates are reminded to read the question/question part thoroughly before they attempt a response.

Candidate's Response to Part (c) (ii) – Sample 1

Name ONE feature that would enable a scientist to distinguish a spherical bacterial cell from an animal cell when viewed under a microscope.

An animal cell contains a prominent, clearly defined nucleus that bacterial cells don't

(1 mark)

Candidate's Response to Part (c) (ii) – Sample 2

Name ONE feature that would enable a scientist to distinguish a spherical bacterial cell from an animal cell when viewed under a microscope.

Bacterial cells have pili and a cell wall while animal cells have neither of th

(1 mark)

Candidate's Response to Part (c) (ii) – Sample 3

Name ONE feature that would enable a scientist to distinguish a spherical bacterial cell from an animal cell when viewed under a microscope.

(1) In animal cell, cell wall is not present

(1 mark)

Candidate's Response to Part (c) (ii) – Sample 4

Name ONE feature that would enable a scientist to distinguish a spherical bacterial cell from an animal cell when viewed under a microscope.

Spherical bacterial cell will have a murein cell wall while animal cells do not.

(1 mark)

Examiner's Comments

Each of these candidates were awarded the mark allotted to this part of the question. A definitive answer is *the absence of a nucleus* or *the presence of a cell wall*.

Question 2

This question tested Specific Objectives C 2.4 and 2.6. The question required candidates to describe the process of meiosis using terms such as *homologous pairs, crossing over, separation of homologous chromosomes* and subsequent *separation of chromatids* as well as to explain the role of meiosis in the transmission of inheritable genetic characteristics.

Part (a) (i) presented candidates with an incomplete diagram of meiosis in an animal cell where four genetically different daughter cells were produced. For four marks, candidates, given the contents of two daughter cells, were asked to complete the figure by drawing the contents of the other two daughter cells shown on the diagram. This part of the question was worth four marks and most candidates gained at least two marks.

Acceptable responses included a relative representation of the shape and pattern of the chromosomes. Most responses correctly had one solid C-shaped chromosome and one dotted S-shaped chromosome in one cell and one dotted C-shaped chromosome and one solid S-shaped chromosome in the other cell. Some candidates also produced accurate diagrams showing recombinant chromosomes.

Common misconceptions included the following.

- More than two chromosomes in each of the two cells
- Cells showing homologous chromosomes aligning at the equator
- Incorrect placement of chromosomes in each cell
- Misunderstanding the diagram given in the stem of the question

Candidate's Response to Part (a) (i) – Sample 1

Figure 3 is an incomplete diagram of meiosis in an animal cell. Four genetically different daughter cells, P, Q, R and S, are produced.

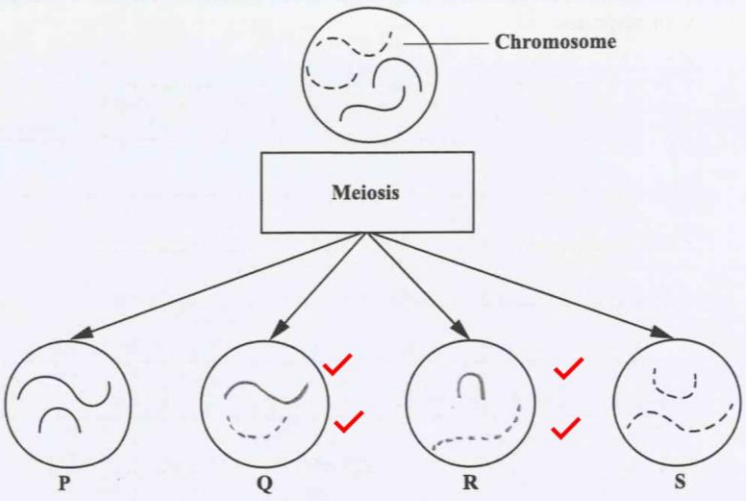


Figure 3. Partial diagram of the process of meiosis in an animal cell

(a) (i) Complete Figure 3 by drawing the contents of the daughter cells Q and R on the diagram. **(4 marks)**

Candidate's Response to Part (a) (i) – Sample 2

Figure 3 is an incomplete diagram of meiosis in an animal cell. Four genetically different daughter cells, P, Q, R and S, are produced.

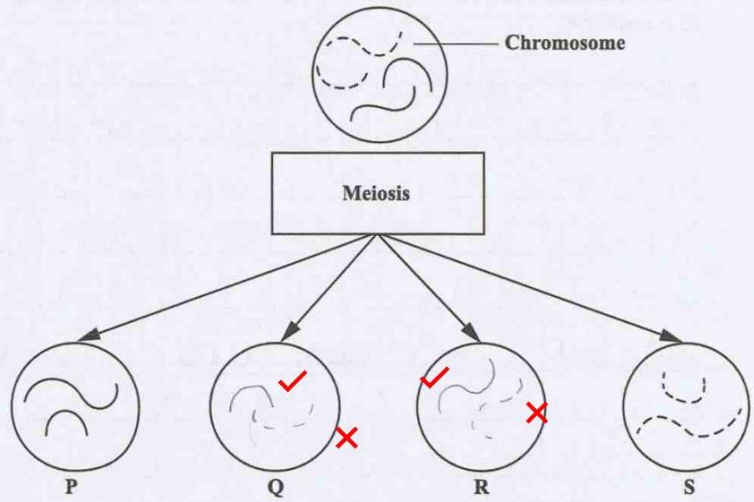


Figure 3. Partial diagram of the process of meiosis in an animal cell

(a) (i) Complete Figure 3 by drawing the contents of the daughter cells Q and R on the diagram. **(4 marks)**

Candidate's Response to Part (a) (i) – Sample 3

Figure 3 is an incomplete diagram of meiosis in an animal cell. Four genetically different daughter cells, P, Q, R and S, are produced.

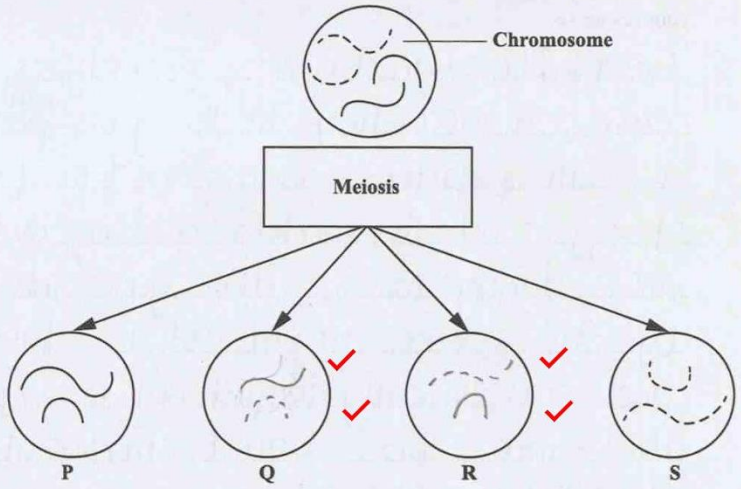


Figure 3. Partial diagram of the process of meiosis in an animal cell

(a) (i) Complete Figure 3 by drawing the contents of the daughter cells Q and R on the diagram. **(4 marks)**

Candidate's Response to Part (a) (i) – Sample 4

Figure 3 is an incomplete diagram of meiosis in an animal cell. Four genetically different daughter cells, P, Q, R and S, are produced.

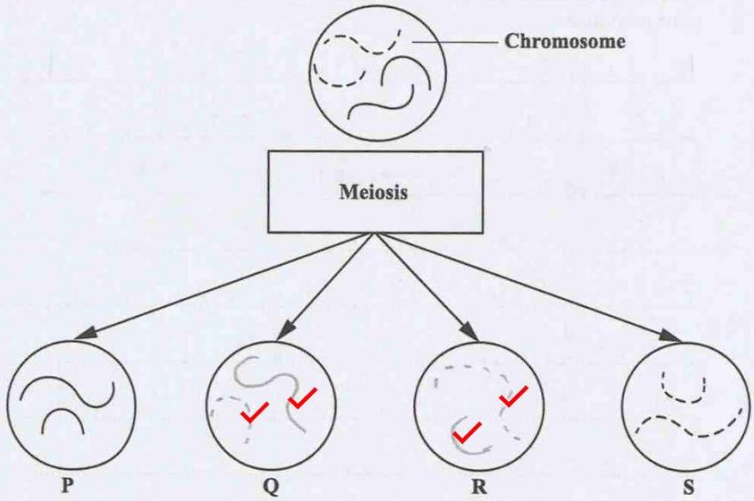


Figure 3. Partial diagram of the process of meiosis in an animal cell

(a) (i) Complete Figure 3 by drawing the contents of the daughter cells Q and R on the diagram. **(4 marks)**

Candidate's Response to Part (a) (i) – Sample 5

Figure 3 is an incomplete diagram of meiosis in an animal cell. Four genetically different daughter cells, P, Q, R and S, are produced.

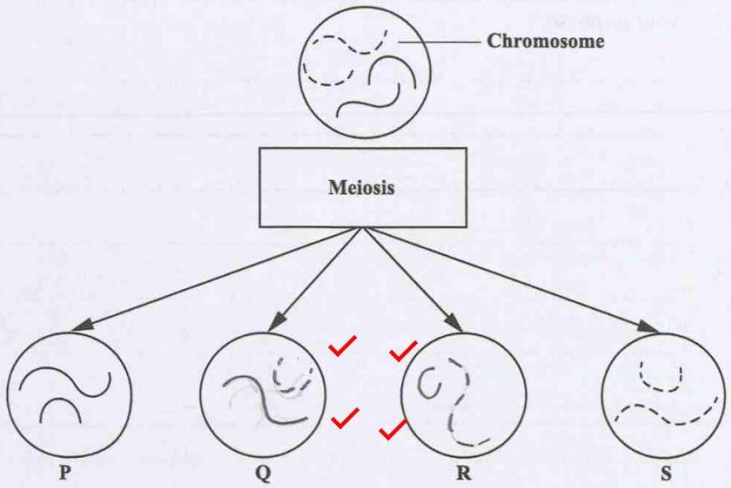


Figure 3. Partial diagram of the process of meiosis in an animal cell

(a) (i) Complete Figure 3 by drawing the contents of the daughter cells Q and R on the diagram. **(4 marks)**

Examiner's Comments

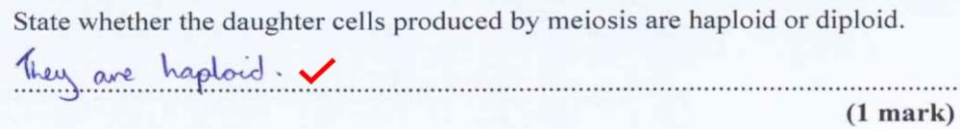
The four candidates' responses shown above were awarded all the marks. They understood the concept of the separation of homologous chromosomes during meiosis and the subsequent separation of chromatids.

Part (a) (ii) required candidates to state whether the daughter cells produced by meiosis were haploid or diploid.

It appeared that there was some confusion since a significant number of candidates seemed undecided. Some candidates wrote the correct answer then cancelled it, replacing it with the incorrect one. These kinds of responses highlight the importance of complying with the syllabus requirement of memorizing the details underlying specific processes. The trend/incident/occurrence also underscores the need for candidates to be acquainted with the scientific jargon used to explain those processes. Many candidates lost one mark needlessly because they were undecided about whether the daughter cells produced by meiosis were haploid or diploid.

The correct answer is *haploid.*

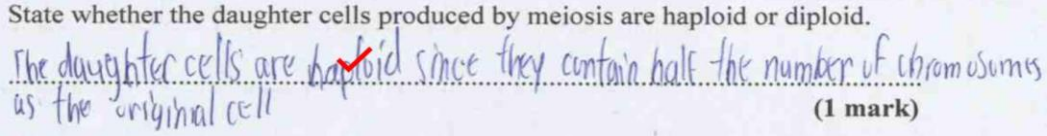
Candidate's Response to Part (a) (ii) – Sample 1


State whether the daughter cells produced by meiosis are haploid or diploid.

They are haploid. ✓

(1 mark)

Candidate's Response to Part (a) (ii) – Sample 2


State whether the daughter cells produced by meiosis are haploid or diploid.

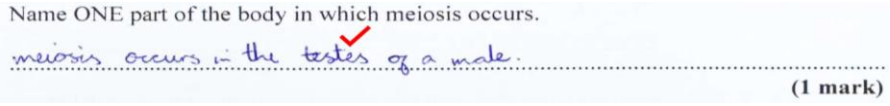
The daughter cells are haploid since they contain half the number of chromosomes as the original cell

(1 mark)

Examiner's Comments
Both candidates gained the mark for correctly identifying that the daughter cells produced are haploid.

Part (b) asked candidates to name one part of the body in which meiosis occurs. Acceptable responses were *ovary/ovaries; testis/testes; testicle/testicles or gonads.* Incorrect responses included reproductive organs (too vague), for example, 'oviduct', 'vagina', 'cervix', 'uterus', 'womb'; 'rye', 'skin', 'stomach', 'blood'; 'sex cells'.

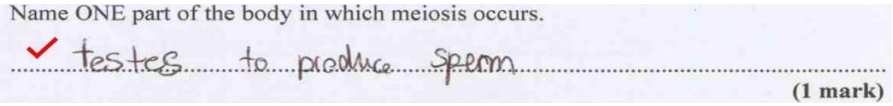
Candidate's Response to Part (b) – Sample 1


Name ONE part of the body in which meiosis occurs.

meiosis occurs in the testes of a male.

(1 mark)

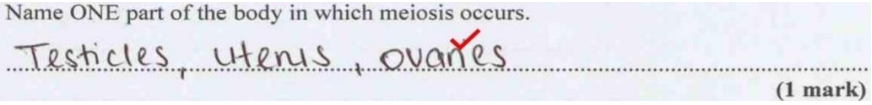
Candidate's Response to Part (b) – Sample 2


Name ONE part of the body in which meiosis occurs.

✓ testes to produce sperm

(1 mark)

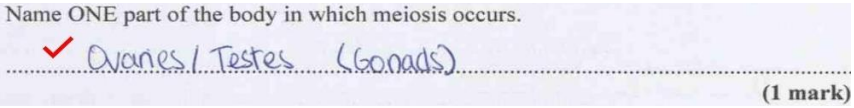
Candidate's Response to Part (b) – Sample 3


Name ONE part of the body in which meiosis occurs.

Testicles, Uterus, ovaries

(1 mark)

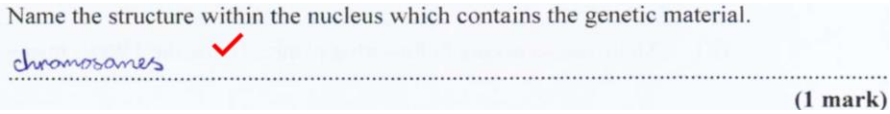
Candidate's Response to Part (b) – Sample 4



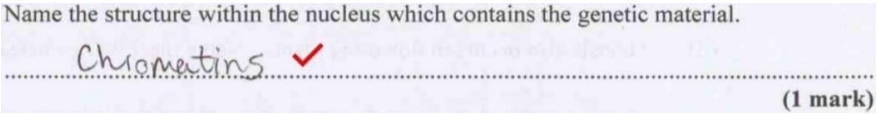
Examiner's Comments
All four candidates correctly identified one part of the body where meiosis occurs.

Part (c) required the name of the structure within the nucleus which contains the genetic material. Acceptable responses were *chromosome, chromatid, DNA, chromatin, and chromatin threads*. Incorrect responses included 'nucleolus', 'nucleus', 'nuclear membrane', 'ribosomes', 'ovaries', 'cytoplasm', 'mitochondria'.

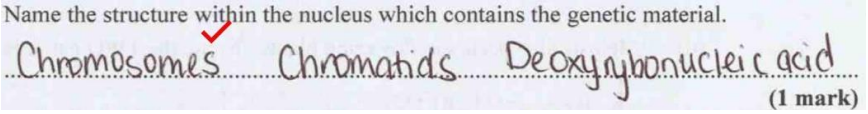
Candidate's Response to Part (b) – Sample 1



Candidate's Response to Part (b) – Sample 2



Candidate's Response to Part (b) – Sample 3



Examiner's Comments
All three candidates gained the mark for naming chromosome, chromatid, chromatin, or DNA.

For Part (d), candidates were required to use their knowledge of genetics to explain why the observable characteristics in the two sisters, Khara and Keturah, were different from their parents. Candidates had to give two reasons. An example of an acceptable response is shown below.

In meiosis, the daughter cells that are produced are genetically different from each other/not identical and this causes the daughters to have different characteristics when the male and female gametes fuse in sexual reproduction. This is due to the type of alleles they have.
Mutation could have occurred in the cells of one or both daughters which changes the DNA sequence of the daughters and may change the observable characteristics of them.

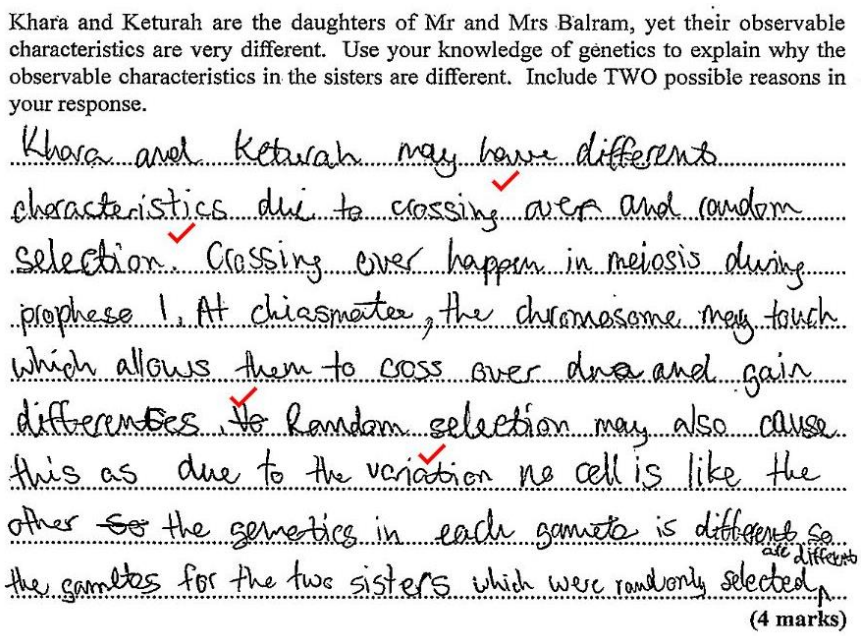
Many candidates understood the underlying concept but were unable to provide clear explanations to substantiate their understanding of genetics as it relates to the question. Terms such as allele, gene, homozygous and heterozygous were used incorrectly and indiscriminately.

Many candidates also gave incorrect responses, including the following.

- One sister gets more dominant or stronger genes from one parent unlike the other sister.
- Mr and Mrs Balram were not the biological parents of Khara and Keturah.
- The sisters got the genes or traits from their grandparents.
- Dominant genes from the father are passed on to one daughter while the recessive genes from the mother are passed on to the next sister.
- One sister inherited more of the father's traits while the next sister inherited more of the mother's traits.

The following samples are given to highlight various ways in which correct answers were expressed.

Candidate's Response to Part (d) – Sample 1

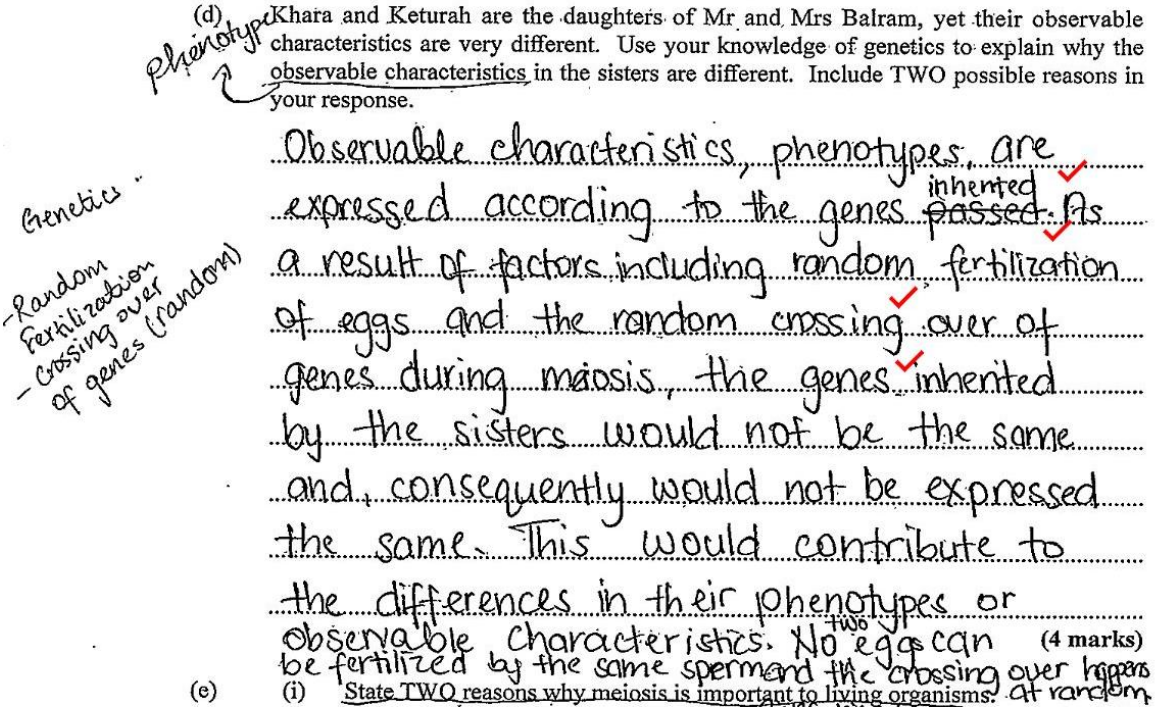


Khara and Keturah are the daughters of Mr and Mrs Balram, yet their observable characteristics are very different. Use your knowledge of genetics to explain why the observable characteristics in the sisters are different. Include TWO possible reasons in your response.

Khara and Keturah may have differents characteristics due to crossing over and random selection. Crossing over happen in meiosis during prophese 1. At chiasmata, the chromosome may touch which allows them to cross over dna and gain differentes. ~~to~~ Random selection may also cause this as due to the variation no cell is like the other ~~so~~ the genetics in each gamete is different so are different the gametes for the two sisters which were randomly selected.

(4 marks)

Candidate's Response to Part (d) – Sample 2



(d) Khara and Keturah are the daughters of Mr and Mrs Balram, yet their observable characteristics are very different. Use your knowledge of genetics to explain why the observable characteristics in the sisters are different. Include TWO possible reasons in your response.

phenotype

Observable characteristics, phenotypes, are expressed according to the genes inherited ~~passed~~. As a result of factors including random fertilization of eggs and the random crossing over of genes during meiosis, the genes inherited by the sisters would not be the same and, consequently would not be expressed the same. This would contribute to the differences in their phenotypes or observable characteristics. No two egg can be fertilized by the same sperm and the crossing over happens at random. (4 marks)

Genetics

- Random Fertilization
- Crossing over of genes (random)

(e) (i) State TWO reasons why meiosis is important to living organisms.

Candidate's Response to Part (d) – Sample 3

Khara and Keturah are the daughters of Mr and Mrs Balram, yet their observable characteristics are very different. Use your knowledge of genetics to explain why the observable characteristics in the sisters are different. Include TWO possible reasons in your response.

1. In meiosis, the daughter cells that are produced are genetically different from eachother/not identical and this causes the daughters to have different ~~characteristics~~ characteristics when the male and female gametes fuse in sexual reproduction. This is due to the type of alleles they have.
2. Mutation could have occured in the cells of one or both of the daughter which changes the DNA sequence of the daughters and may change the observeable characteristics of them

(4 marks)

Candidate's Response to Part (d) – Sample 4

Khara and Keturah are the daughters of Mr and Mrs Balram, yet their observable characteristics are very different. Use your knowledge of genetics to explain why the observable characteristics in the sisters are different. Include TWO possible reasons in your response.

The observable characteristics are different in the sisters because of the crossing over of chromatids on homologous pairs of chromosomes which takes place in phophase I of meiosis. The outcome is that the chromosomes in the daughter cells are genetically varied. Additionally, ~~after~~ the homologous chromosomes are lined up differently (metaphase I) everytime a cell undergoes meiosis thus they ~~split~~ split up into different (anaphase I) combinations of chromosomes producing genetically varied daughter cells that form ~~to~~ zygotes with similar, but different characteristics of each parent and other sex cell. **(4 marks)**

Examiner's Comments

These candidates each gained full marks. They were able to explain the role of meiosis in the transmission of genetic characteristics that are heritable, emphasizing crossing over, random assortment and recombination in genetic variation – the benefits of sexual reproduction.

Part (e) (i) asked candidates to state two reasons why meiosis is important to living organisms. Expected responses were as follows.

- Ensures that all organisms produced via sexual reproduction contain the correct number of chromosomes
- Passes on genes that may be helpful in adaptation which promotes survival of the species/prevents extinction
- Produces genetic variation (through recombination)
- Allows sexual reproduction of diploid organisms
- Enables genetic diversity
- Continually reshuffles the genes
- Produces sex cells (gametes)
- Is necessary for fertilization to occur
- Allows for natural selection

Here is an example of an acceptable response.

> *It causes variation in organisms allowing them to be well adapted to their environment. It also ensures that the species isn't completely wiped out due to diseases.*

Some misconceptions included the following.

- It is important for asexual or sexual reproduction. (Candidates needed to be specific regarding the type of reproduction.)
- To gain traits from the parents
- For growth and repair of tissues
- To create chromosomes in offspring
- To multiply and divide cells
- To help create more plants
- For the correct number of cells

The following samples are given to highlight various ways in which correct answers were expressed.

Candidate's Response to Part (e) (i) – Sample 1

(i) State TWO reasons why meiosis is important to living organisms.

Meiosis brings variation due to crossing over ~~they are not~~ the products are never the same allowing ~~for~~ for more variation. Meoisis also ~~assist~~ assists in adaptation to environmental changes as cells ~~with~~ will be different so changes in the environment ~~to~~ does not affect all organisms allowing some to live.

Candidate's Response to Part (e) (i) – Sample 2

(i) State TWO reasons why meiosis is important to living organisms.

Allows for speciation, gives rise to genetic variation, the continued survival of a species through reproduction.

Candidate's Response to Part (e) (i) – Sample 3

(i) State TWO reasons why meiosis is important to living organisms.

1. Meiosis is important to living organisms so that organisms will be able to sexually reproduce and produce offspring.

2. Meiosis is important to living organisms since they cause variation in the offspring which would allow the offspring to adapt to changes in the environment which is needed to prevent the organisms extinction (2 marks)

Candidate's Response to Part (e) (i) – Sample 4

(i) State TWO reasons why meiosis is important to living organisms.

Meiosis is important to living organisms because it produces the sex cells (gametes) necessary in sexual reproduction to produce more living (offspring) organisms. In addition, meiosis is responsible for the genetic variety in living organisms which ~~can prevent extinction of the~~ is responsible for the organisms that survive threats (diseases) due to their varied genes that may be suitable for changing environments (2 marks)

Examiner's Comments

All four candidates were able to correctly identify the importance of meiosis to living organisms.

Part (e) (ii) required candidates to name two gametes that are produced when meiosis occurs in flowering plants. Common errors observed were candidates' use of 'anther', 'stamen', and 'seed' when it should have been *male gametes/pollen*. In addition, instead of *ovule or female gametes*, many candidates wrote 'stigma', 'fruit', or 'carpel'.

Candidate's Response to Part (e) (ii) – Sample 1

(ii) Meiosis also occurs in flowering plants. Name the TWO gametes produced.

The two gametes produced are:

(1) pollen grains (male gamete)

(2) ovule (female gametes)

(2 marks)

Candidate's Response to Part (e) (ii) – Sample 2

(ii) Meiosis also occurs in flowering plants. Name the TWO gametes produced.

Pollen from the anther and ovums in the ovary are two gametes produced

(2 marks)

Candidate's Response to Part (e) (ii) – Sample 3

(ii) Meiosis also occurs in flowering plants. Name the TWO gametes produced.

Pollen grains, ovum / eggs

(2 marks)

Examiner's Comments

These three candidates gained full marks for correctly naming the gametes produced in flowering plants.

Question 3

This question tested Specific Objectives A1.1, 1.2, 6.5. The question required candidates to group living organisms based on observed similarities and differences, classify organisms based on external similarities and suggest means by which the environment could be conserved.

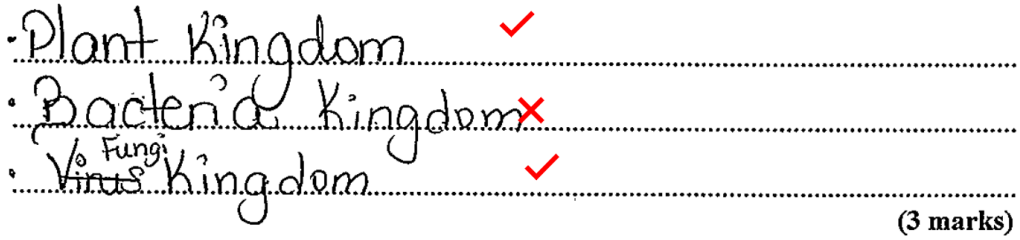
There was a mixed performance on the question parts. Some candidates performed well in all sections, while some performed well in only specific parts and others opted not to provide responses for parts or all of the questions.

Part (a) required candidates to list three kingdoms other than the animal kingdom. The appropriate answers were the plant kingdom, Fungi, Prokaryote and Protista/Protoctista. Candidates were generally able to score at least one mark for this question. However, several errors were noted in responses which included the following.

- The misinterpretation of kingdom to mean types of organisms, for example, bacteria, air, land water.
- The indication of the virus as a kingdom
- Giving the classification within the animal kingdom and indicating phylum, genus, species or class.
- The organization of organisms into cells, tissue, and organ system
- Including Saprophyte as a kingdom.

Candidate's Response to Part (a) – Sample 1

(a) List THREE kingdoms, other than the animal kingdom, into which organisms can be classified.



(3 marks)

Examiner's Comments

This candidate was awarded two marks for providing two accurate kingdoms. No marks were awarded for 'bacteria'.

Candidate's Response to Part (a) – Samples 2, 3, 4 and 5

(a) List THREE kingdoms, other than the animal kingdom, into which organisms can be classified.

1. Plantae (plants) ✓
2. Fungi (decomposers) ✓
3. Prokaryotes (multi-cellular organisms) ✓

BOD

(3 marks)

(a) List THREE kingdoms, other than the animal kingdom, into which organisms can be classified.

Plant kingdom, Plant kingdom ✓
• Protactista
• Prokary Prokaryotes ✓

(3 marks)

(a) List THREE kingdoms, other than the animal kingdom, into which organisms can be classified.

Fungi ✓, ~~Plantae (Plants) an~~
Plantae (Plants) ✓
Prokaryotae (Prokaryotes) ✓

(3 marks)

(a) List THREE kingdoms, other than the animal kingdom, into which organisms can be classified.

Three kingdoms which organisms can be classified are
fungi kingdom ✓, plant kingdom ✓ and protocists ✓ kingdom.

(3 marks)

Examiner's Comments

The last four candidates were awarded the three marks. No marks were deducted for the spelling error.

Part (b) (i) required candidates to refer to an image showing six fish and list three visible characteristics that may be used to classify the fish. Appropriate responses included *structure of mouth, shape of the head, fin type, number of fins, structure/arrangement of fins, shape of body, type of pattern*, and *presence/absence of scales*.

Most candidates were able to score at least one mark for this question. The most common error seen was candidates simply providing the body part used for classification without stating what particular characteristic about the indicated body part was being used to classify/group the fish.

Candidate's Response to Part (b) (i) – Sample 1

(i) List THREE visible characteristics that may be used to classify the fish in Figure 4.

1. Scales (who has or who doesn't have)
2. Fins (number & gills)
3. Tails (double or single)

(3 marks)

Candidate's Response to Part (b) (i) – Sample 2

(i) List THREE visible characteristics that may be used to classify the fish in Figure 4.

- ~~Stripes pattern~~ Pattern on fish
- Number of fins
- ~~Spots pattern~~ Type of mouth

(3 marks)

Examiner's Comments

Each candidate provided three accurate examples of visible characteristics that could be used to classify the fish shown in the image. They were each awarded three marks.

Part b (ii) required candidates to refer to the image of the six fish, select one of the characteristics they had listed in Part (b) (i), and then arrange the fish in the image into two groups using the selected characteristic. Candidates had the greatest difficulty with this section. Here candidates had the following misconceptions or difficulties.

- Using fins and gills interchangeably
- Using more than one characteristic. Here candidates often attempted to use the two columns to describe two different characteristics which may indicate either a misinterpretation of the question or a misinterpretation of the table.
- Indicating a vague characteristic, for example, simply stating 'fins' instead of *number of fins* or *arrangement of fins*.

- Stating a characteristic and then not accurately grouping the fish based on the characteristic indicated.

Some candidates simply did not provide a response.

Candidate's Response to Part (b) (ii) – Sample 1

(ii) Using any ONE of the characteristics listed in (b) (i), arrange the fish species (A–F) into **two** groups, I and II, in Table 3 below.

TABLE 3: SPECIES OF FISH ARRANGED INTO TWO GROUPS, I AND II

Group I Characteristic Used: Small mouth shapes	Group II Characteristic Used: Irregular ~~and~~ or large mouth
A	E
D	C
B	F

(4 marks)

Candidate's Response to Part (b) (ii) – Sample 2

(ii) Using any ONE of the characteristics listed in (b) (i), arrange the fish species (A–F) into **two** groups, I and II, in Table 3 below.

TABLE 3: SPECIES OF FISH ARRANGED INTO TWO GROUPS, I AND II

Patterns

Group I Characteristic Used: Stripes	Group II Characteristic Used: Spotted
A	E
B	F
C	
D	

(4 marks)

Candidate's Response to Part (b) (ii) – Sample 3

(ii) Using any ONE of the characteristics listed in (b) (i), arrange the fish species (A–F) into **two** groups, I and II, in Table 3 below.

TABLE 3: SPECIES OF FISH ARRANGED INTO TWO GROUPS, I AND II

Group I Characteristic Used: Double Pairs	Group II Characteristic Used: Single Pairs
C	~~B~~
E	B
F	D

(4 marks)

Candidate's Response to Part (b) (ii) – Sample 4

(ii) Using any ONE of the characteristics listed in (b) (i), arrange the fish species (A–F) into **two** groups, I and II, in Table 3 below.

TABLE 3: SPECIES OF FISH ARRANGED INTO TWO GROUPS, I AND II

Group I Characteristic Used: Pattern C Stripes)	Group II Characteristic Used: Pattern (No Stripes)
A	E
B	F
D	C

(4 marks)

Examiner's Comments

The samples show how four candidates used four different accurate characteristics for classification and were able to place all the fish bearing the identified characteristic into the correct group. Each candidate in the sample was awarded the full four marks.

Candidate's Response to Part (b) (ii) – Sample 5

(ii) Using any ONE of the characteristics listed in (b) (i), arrange the fish species (A–F) into **two** groups, I and II, in Table 3 below.

TABLE 3: SPECIES OF FISH ARRANGED INTO TWO GROUPS, I AND II

Group I Characteristic Used Varying body pattern	Group II Characteristic Used Varying body pattern
A	E
B	F
D	
C	

(4 marks)

Examiner's Comments

In this fifth sample, it was unclear what the candidate meant by "varying body pattern" or what characteristic was being used to group the fish. The response required more detail indicating how the body pattern varied. The candidate was not awarded any marks for this response.

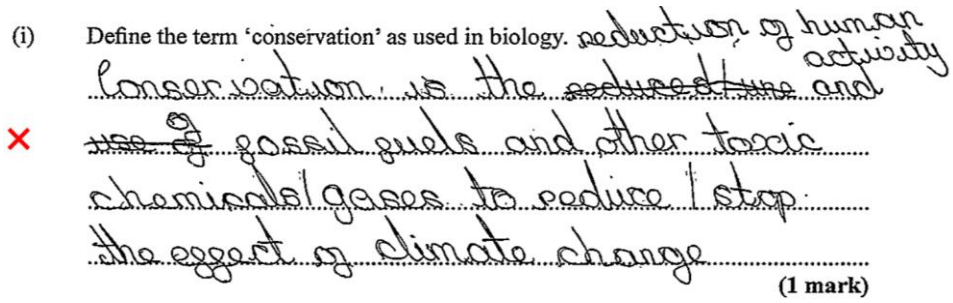
In Part (c) (i), candidates were required to provide a biological definition of the word "conservation". Many candidates were able to score the one mark awarded for this question. Accurate responses included the following.

- Conservation biology is a discipline that focuses on protecting and restoring the Earth's biodiversity.
- The study of the loss of earth's biological diversity and the methods which may prevent it.
- Conservation is the preservation and/or protection of organisms in a particular habitat to prevent extinction.
- Conservation is the deliberate and controlled careful use of resources and organisms to protect both the environment and its inhabitants.

Common inaccurate definitions provided by candidates included the following.

- Saving resources, for example, water, minerals etc. (not focused on biological definition).
- Conservation of energy
- Conservation is the saving of something
- Conservation is the act of storing or preserving

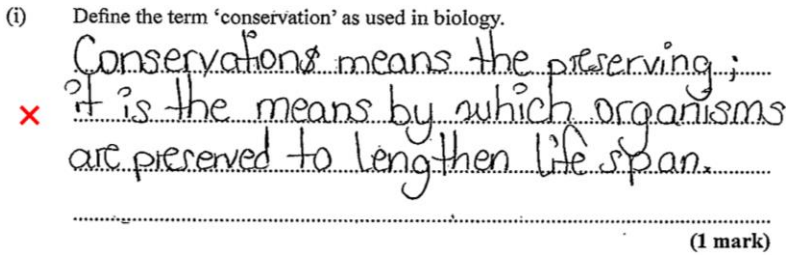
Candidate's Response to Part (c) (i) – Sample 1



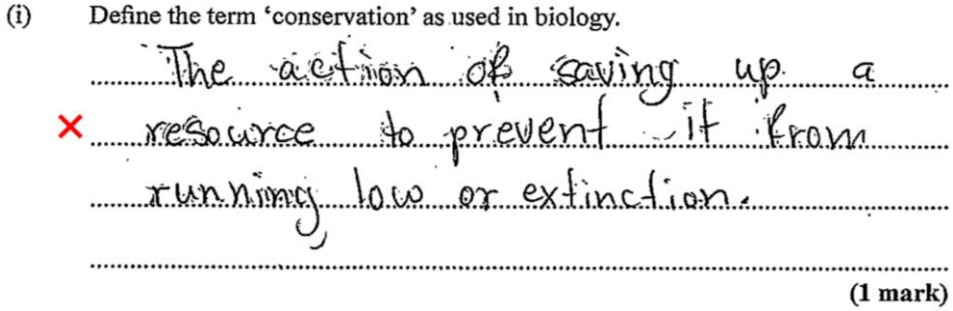
Examiner's Comments

While this candidate provided some examples of conservation techniques, no accurate definition was given; hence, the mark was not awarded.

Candidate's Response to Part (c) (i) – Sample 2



Candidate's Response to Part (c) (i) – Sample 3



Candidate's Response to Part (c) (i) – Sample 4

(i) Define the term 'conservation' as used in biology.

Conservation - the process of stabilizing a living organism habitat so it does not go into extinction due to loss of habitat, pollution and over harvesting.

(1 mark)

Candidate's Response to Part (c) (i) – Sample 5

(i) Define the term 'conservation' as used in biology.

Conservation refers to the saving of resources.

(1 mark)

Examiner's Comments

Samples 2 to 5 above all represented inaccurate definitions, so none of these candidates were awarded the mark allotted for this part of the question.

In Part (c) (ii), candidates were required to explain two methods of conservation which may be used to minimize threats to fish populations living on coral reefs in the Caribbean. Many candidates scored at least two marks for this question. Appropriate responses included the following.

- Minimize the use of plastic products and their consumption/use alternative products such as paper bags, cloth totes or other reusable bags when shopping/use sustainable products that are marine friendly. Plastics can contribute to habitat destruction which may kill the fish population. Alternative products are therefore encouraged.
- Promotional efforts that support beach conservation/Offering financial support or support to volunteer groups to do beach clean-ups. There are many groups who are willing to do work to protect ocean habitats and marine life. Support in this area will lead to beach conservation.
- Instituting or enforcing laws/legislation that prohibit(s) damage to coral reefs. Enforcement of laws/legislation/penalties would deter persons from causing damage to marine life.
- Implement a captive breeding program. Rear in a facility and increase the population as fish are released to the wild.

- Implement fishing seasons to stop or reduce fishing on the coral reef. Overfishing can deplete the fish population of the coral reef and damage the reef habitat. This measure will allow the fish time to reproduce in the down/off-season.
- Educate the population to restrict/reduce/prevent pollution. This would reduce damage to the coral reef and the associated organisms.

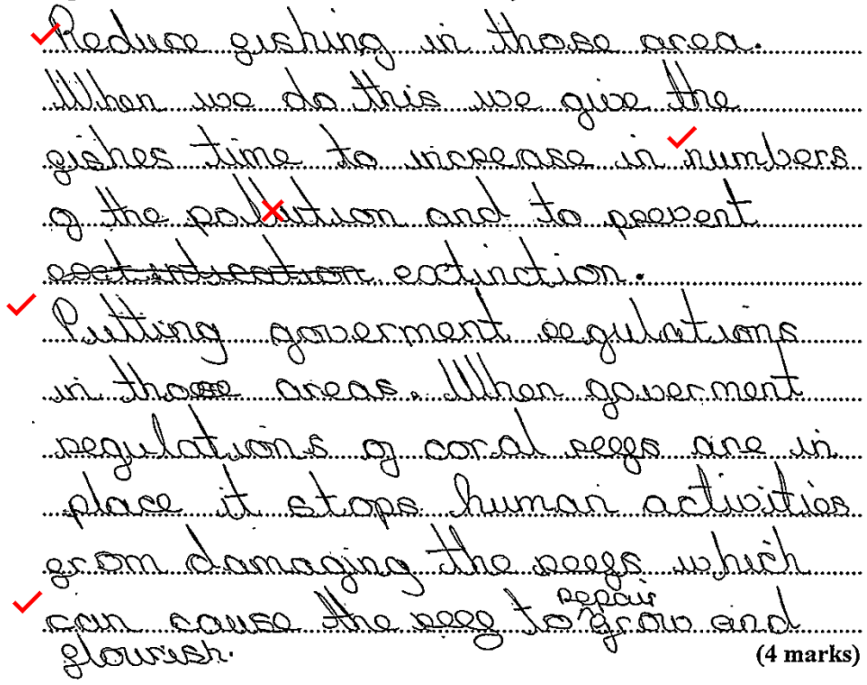
Common errors and misconceptions seen in responses given by candidates included the following.

- Stating the conservation method(s) without providing an accompanying explanation
- Providing a description of the method(s) without giving the appropriate explanation.

Candidate's Response to Part (c) (ii) – Sample 1

(ii) Fish populations which live on coral reefs in the Caribbean are under a threat of extinction due to predation and pollution.

Explain TWO methods of conservation that may be used to minimize these threats.



(4 marks)

Examiner's Comments

This candidate was able to accurately identify two conservation methods and explain how they minimized the threat to the fish populations living on coral reefs. The four marks were awarded.

Candidate's Response to Part (c) (ii) – Sample 2

(ii) Fish populations which live on coral reefs in the Caribbean are under a threat of extinction due to predation and pollution.

Explain TWO methods of conservation that may be used to minimize these threats.

• One method of conservation can be ~~be~~ to introduce natural predators of the fish's predators. This will help to control the population of fish predators and conserve the lives of the fish.

• Another method of conservation is to have programs set in place to remove pollution. (for e.g., volunteer can remove garbage, or specialists can treat the water in cases like oil spills).

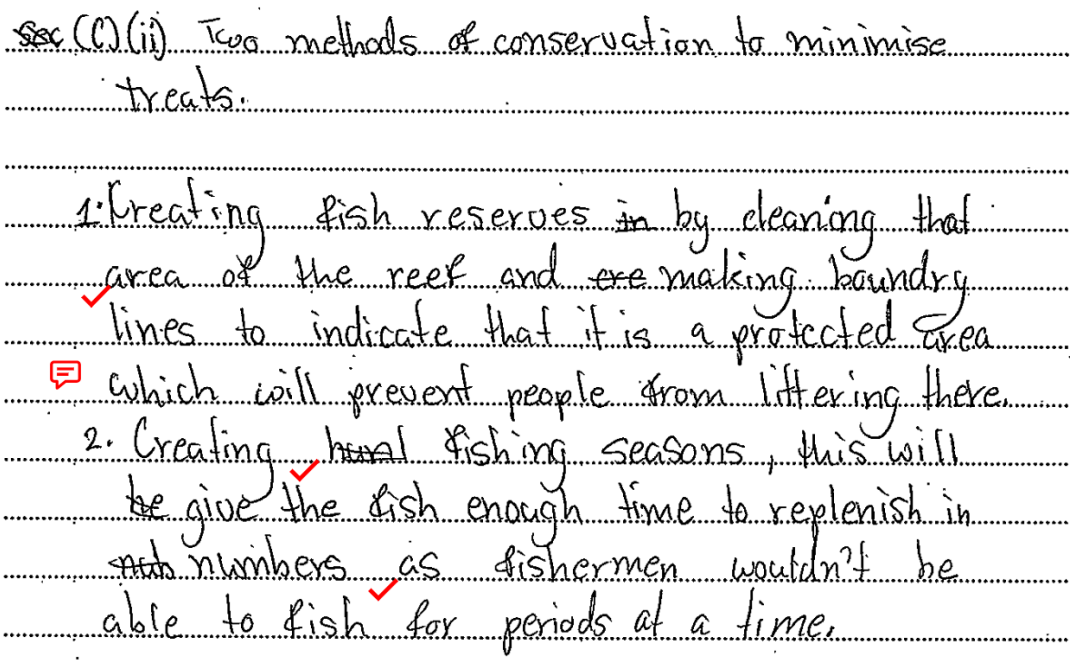
(4 marks)

Examiner's Comments

This candidate was able to accurately identify one conservation method (programmes to remove pollution) but was unable to explain how it would minimize the threat to the fish populations living on coral reefs. Only one mark was awarded.

Marks could not be awarded for the first point of introducing predators into the fish population as this could lead to other problems within the established ecosystem.

Candidate's Response to Part (c) (ii) – Sample 3



Examiner's Comments

This candidate was able to accurately identify two conservation methods but was unable to clearly explain how one of them would minimize the threat to the fish populations living on coral reefs. The candidate therefore received three marks for the response.

Candidate's Response to Part (c) (ii) – Sample 4

(ii) Fish populations which live on coral reefs in the Caribbean are under a threat of extinction due to predation and pollution.

Explain TWO methods of conservation that may be used to minimize these threats.

~~Impose - Implement on/off seasons for these fish populations to replenish reproduce~~

Implement a law on/off seasons, that is during the on season, fishermen/women are to allowed to capture fishes ~~for~~ to ply their trade, and during the off season, no one is allowed to fish, thus the fishes are given a chance to reproduce.

Impose heavy fines if individuals do not adhere to the aforementioned law, that they may be charged or even force ~~to~~ jail time for breaking the law.

(4 marks)

Examiner's Comments

This candidate was able to accurately identify one conservation method and was able to explain how it would minimize the threat to the fish population living on coral reefs. The entire response was worth two marks since the last paragraph is simply an expansion of the point which had already been made and awarded.

Candidate's Response to Part (c) (ii) – Sample 5

(ii) Fish populations which live on coral reefs in the Caribbean are under a threat of extinction due to predation and pollution.

Explain TWO methods of conservation that may be used to minimize these threats.

Two methods of conservation that may be used to minimize the threat of:

Predation - instead of commercial fishing we can do farm fishing which gives us the control of the type of fish we need and want.

Pollution - we can stop using plastic material and biodegradeable material which can prevent the choking of fish and the poisoning of corals.

(4 marks)

Examiner's Comments

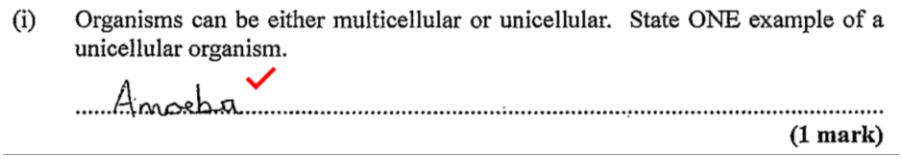
This candidate was able to accurately identify one conservation method and was able to explain how it would minimize the threat to the fish populations living on coral reefs. Two marks were awarded.

Question 4

This question tested Specific Objectives B 4.1, 4.2,4.7, 4.8, 4.11. The question required candidates to explain the need for transport systems in multicellular organisms, identify the materials which are transported in multicellular organisms, explain how the structure of the xylem is suitable for its function, discuss the process of transpiration in plants and explain how the structure of the phloem is suited to its function.

In Part (a) (i), candidates were required to identify an example of unicellular organisms. The question was generally well done, and most candidates were able to identify an example of unicellular organisms, for example, *bacteria* and *amoeba*. Other appropriate responses included *euglena, paramecium, plasmodium, salmonella sp., protozoans,* and *algae*. However, some candidates did not have a clear understanding of what unicellular organisms are, as evidenced by inaccurate answers such as 'humans', 'plants', and 'xylem'. Such candidates generally did poorly in the entire question.

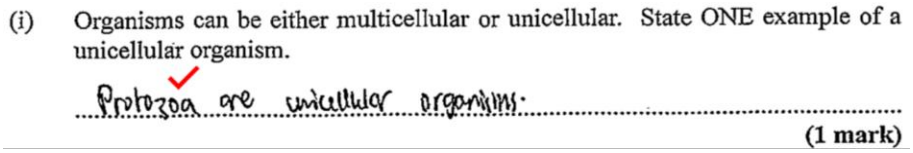
Candidate's Response to Part (a) (i) – Sample 1


(i) Organisms can be either multicellular or unicellular. State ONE example of a unicellular organism.

Amoeba

(1 mark)

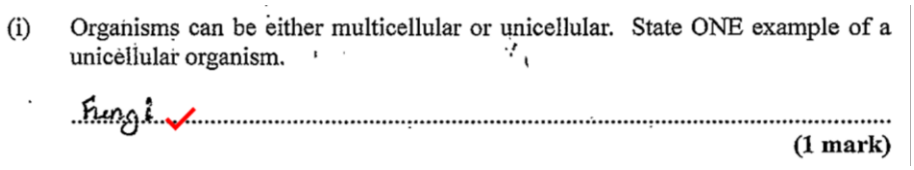
Candidate's Response to Part (a) (i) – Sample 2


(i) Organisms can be either multicellular or unicellular. State ONE example of a unicellular organism.

Protozoa are unicellular organisms.

(1 mark)

Candidate's Response to Part (a) (i) – Sample 3


(i) Organisms can be either multicellular or unicellular. State ONE example of a unicellular organism.

Fungi

(1 mark)

Examiner's Comments

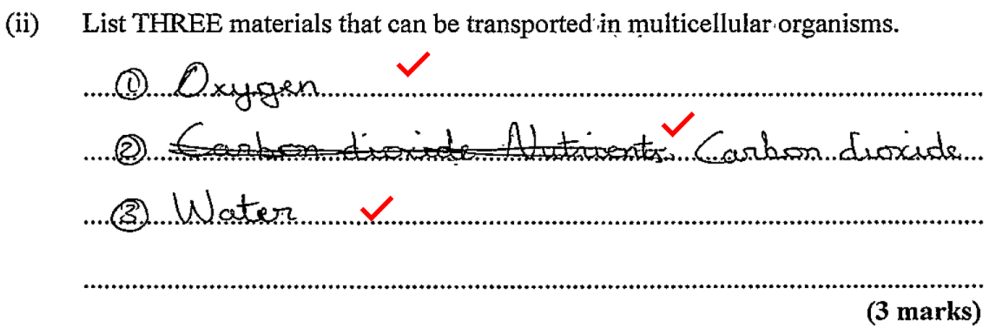
These candidates provided accurate examples and were each awarded one mark.

In Part (a) (ii), candidates were asked to identify three materials transported in multicellular organisms. This part was generally well done with most candidates being awarded at least two of the three marks. Appropriate answers included the following.

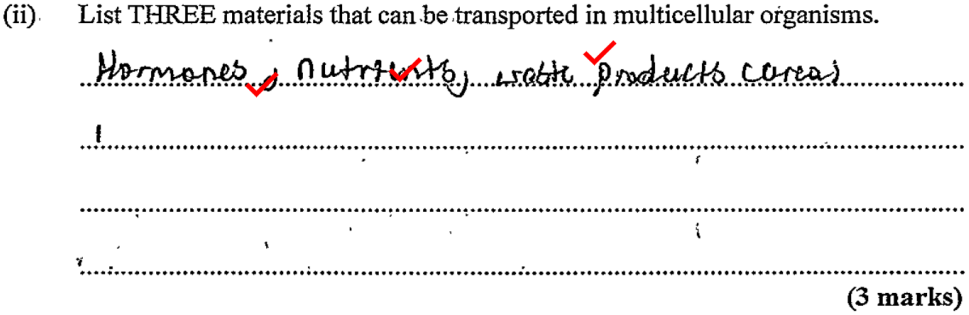
- Oxygen
- Carbon dioxide
- Hormones
- Minerals/nutrients/vitamins/dissolved food molecules/food
- Glucose
- Amino acids
- Urea/waste products/waste materials
- Water
- Heat

However, many candidates indicated blood as a material being transported rather than it being the medium for transporting the material.

Candidate's Response to Part (a) (ii) – Sample 1



Candidate's Response to Part (a) (ii) – Sample 2



Candidate's Response to Part (a) (ii) – Sample 3

(ii) List THREE materials that can be transported in multicellular organisms.

Three materials ~~organisms~~ organisms are:
(i) ~~food~~ nutrients (glucose, amino acids, vitamins)
(ii) gases (carbon dioxide and oxygen)
(iii) waste products (urea, carbon dioxide)

(3 marks)

Examiner's Comments

In these first three samples of responses for Part (a) (ii), the candidates correctly stated three materials transported in unicellular organisms. Each candidate was awarded the three marks.

Candidate's Response to Part (a) (ii) – Sample 4

(ii) List THREE materials that can be transported in multicellular organisms.

Three are: ~~E~~ Blood, oxygen and hormons.

(3 marks)

Examiner's Comments

This candidate was awarded two marks since only two of the materials given are transported in unicellular organisms. No credit was given for stating 'blood' as one of the marterials.

Part (a) (iii) tested the concept of why multicellular organisms need a transport system. This section was poorly answered. Appropriate responses included the following.

- Multicellular organisms are relatively large (larger in size/have a complex structure) so they require a transport system. While unicellular organisms are usually small (smaller in size/have a simpler structure) and hence do not require a transport system.

- Multicellular organisms have large volumes or have a small surface area to volume ratio, so an elaborate transport system is required. Unicellular organisms have small volumes or a large surface area to volume ratio, so an elaborate transport system is not required.
- Plants need vascular bundles for transporting food, minerals, and water. However, in unicellular organisms, nutrients and other substances can quickly pass through the membrane and circulate easily.
- Large multicellular organisms cannot rely on diffusion alone to supply their cells with substances such as food and oxygen. Unicellular organisms can rely on simple diffusion to supply substances such as food and oxygen.

Common misconceptions included the following.

- Confusing the characteristics of multicellular and unicellular organisms and therefore identifying multicellular organisms as having a large surface area to volume ratio and unicellular organisms as having a small surface area to volume ratio
- Thinking that diffusion never occurs in multicellular organisms rather than it being too slow a process to sustain life
- Misinterpreting the question as asking about the function or use of transport systems in multicellular organisms. Candidates who interpreted the question that way gave answers such as 'to remove waste and to transport oxygen for respiration to occur more efficiently'.

Candidate's Response to Part (a) (iii) – Sample 1

(iii) Explain why multicellular organisms require transport systems while unicellular organisms do not. Include TWO reasons in your response.

- Multicellular organisms require transport systems because they have a small surface area to volume ratio. Multicellur organisms need these transport system in order to supply the organism with everything they need in a timely manner. Unicellular organisms have a large surface area in comparasion to their volume. They can easily diffuse stuff into them whereas multicellular cant,

(4 marks)

Examiner's Comments

This response provided one feature/reason, so only two marks were awarded.

Candidate's Response to Part (a) (iii) – Sample 2

(iii) Explain why multicellular organisms require transport systems while unicellular organisms do not. Include TWO reasons in your response.

① Unicellular organisms have a small surface area to volume ratio so diffusion alone is enough whereas multicellular organisms have a large surface area to volume ratio so diffusion alone is not enough to transport substances everywhere quickly enough

② Unicellular organisms are usually one-cell thick so diffusion is quick and easy while multicellular organisms are multiple cells thick so diffusion alone is not efficient so transport systems are needed.

(4 marks)

Examiner's Comments

This candidate also provided one feature/reason, so only two marks were awarded.

Candidate's Response to Part (a) (iii) – Sample 3

(iii) Explain why multicellular organisms require transport systems while unicellular organisms do not. Include TWO reasons in your response.

Multicellular organisms requires a transport system while unicellular organisms do not because the organism contains millions of cells where diffusion, osmosis and active transport would be ineffective in supplying all the cells with food, water and oxygen in a given time period. whereas in unicellular organisms, substances can simply diffuse across the cell's cell surface membrane and is efficient because the organism is made up of only one cell to supply. Another reason is that multicellular organisms posses a small surface area to volume ratio which is unsuitable for diffusion and other process whereas unicellular organisms posses a large surface area to volume ratio which is suitable for diffusion. **(4 marks)**

Examiner's Comments

This candidate provided two features/reasons and included appropriate explanations. Four marks were awarded.

Candidate's Response to Part (a) (iii) – Sample 4

(iii) Explain why multicellular organisms require transport systems while unicellular organisms do not. Include TWO reasons in your response.

1. Multicellular organisms are much more ✓ Complex than unicellular ones and require the transport of different substances to where they are required throughout the body.

2. Unicellur organisms basic structure does not as require presents them opposed to the more complex one in plants.

(4 marks)

Examiner's Comments

This candidate correctly stated one feature/reason with appropriate explanations but only did it for multicellular organisms. The candidate was awarded one mark for the response.

Candidate's Response to Part (a) (iii) – Sample 5

(iii) Explain why multicellular organisms require transport systems while unicellular organisms do not. Include TWO reasons in your response.

Unicellular organisms have ✓ a large surface area to volume ratio meaning that they can just diffuse substances through ~~these~~ their cells ~~membranes~~ and survive. Multicellular organisms have a small ✓ surface area to volume ratio, meaning that they cannot ~~diff~~ simply diffuse substances through their cells because it would not reach ~~all~~ all of the cells in time. They would die.

(4 marks)

Examiner's Comments

This was another candidate who correctly gave one feature/reason with explanation. The candidate was awarded two marks.

In Part (b) (i), candidates were required to define transpiration and translocation. Appropriate responses included the following.

- Translocation
  - Phloem transports sucrose and amino acids/organic substances/food up and down the plant.
  - The transport of sugars and other organic substances through the phloem tubes of a plant.
- Transpiration
  - Transpiration is the process of water movement through a plant and its evaporation from aerial parts such as leaves, stems, and flowers.
  - Transpiration is the loss of water vapour from a leaf; the vapour diffuses out through the stomata.

Many candidates had difficulty defining these terms. Common misconceptions included the following.

- Either defining translocation in terms of the general movement of substances, not relating it to phloem transport, or failing to identify a phloem sieve tube for transporting the food substances
- In defining transpiration, failing to identify that water leaves the plant by evaporation and instead opting to just mention water movement in the plant
- Giving the definition for perspiration instead of the definition for transpiration.

Candidate's Response to Part (b) (i) – Sample 1

(i) Define the terms 'translocation' and 'transpiration'.

- translocation is the process by which food ✓ moves up the phloem vessels to supply the plant with the food/nutrients that it needs. transpiration is the process by which wate moves ✓ through the xylem in adhesion & cohesion of water molecules and exits through the stomata.

(2 marks)

Candidate's Response to Part (b) (i) – Sample 2

(i) Define the terms 'translocation' and 'transpiration'.

Translocation is the movement of food substances (phloem) through the plant from source cells to sink cells or storage organs while transpiration is the evaporation of water from the leaf of the plant (xylem).

(2 marks)

Candidate's Response to Part (b) (i) – Sample 3

(i) Define the terms 'translocation' and 'transpiration'.

'Translocation' refers to the movement and transport of the products of photosynthesis (glucose, sucrose) from a 'source' (any region having or storing glucose) to a sink (any region actively using glucose) via phloem tubes. 'Transpiration' is the loss/evaporation and diffusion of water from the respiratory surfaces of the plant and into the atmosphere.

(2 marks)

Candidate's Response to Part (b) (i) – Sample 4

(i) Define the terms 'translocation' and 'transpiration'.

Transpiration is the process by which water ~~travels~~ absorbed by root hairs travel through the xylem to the leaves of the plant where they're released by the stomata.

Translocation is the process by which food produced substances so the leaves are transported by the phloem to different structures within the plant

(2 marks)

Examiner's Comments

In the four responses above, the candidates defined each of the terms correctly and were each awarded the two marks.

Candidate's Response to Part (b) (i) – Sample 5

(i) Define the terms 'translocation' and 'transpiration'.

Transpiration is the evaporation of water from the surface of the leaf and Translocation is the movement of water from the soil into the plant via osmosis

(2 marks)

Examiner's Comments

This candidate correctly defined the term transpiration but gave an inaccurate definition of translocation. As a result, only one mark was awarded.

In Part (b) (ii), candidates were required to explain two adaptations of the xylem vessel for transportation. Appropriate responses included the following.

- Cells are dead and hollow. Therefore, there are no cytoplasm and cellular organelles to impede the flow of water.
- Cell walls are extra thick with a strengthening substance called lignin and extra cellulose. This keeps the vessels rigid so that they do not collapse under the extreme pressure created by the transpiration pull.
- Cells are elongated and the ends of the cells are eroded/broken down so that a continuous column is created. There is therefore no barrier to the flow of water between neighbouring cells.
- There are small holes along the sides of the cells. This allows for the sideways movement of water to non-xylem cells.
- The xylem vessel is narrow/thin. This allows for capillarity (adhesion and cohesion).

This question was poorly answered. Most candidates failed to accurately identify adaptations and relate the structure to the function. When teaching this concept, teachers should clearly identify these adaptations. Common misconceptions included the following.

- Mixing up xylem vessels with phloem sieve tubes
- Incorrectly linking the hollow tube of xylem with capillarity rather than the thin/narrow tube.

Candidate's Response to Part (b) (ii) – Sample 1

(ii) Explain TWO ways in which the structure of the xylem is suited for its role in transpiration.

The structure of the xylem is specifically structure. It is long and hallow. This is so adhesion & cohesion can occur in the xylem and cause the water molecules to go through them better. The xylem vessels also contain lignin, which is dead organic material. This keeps the xylem upright and rigid. It is also waterproof in order to allow the water to stay inside the xylem.

(4 marks)

Examiner's Comments

This candidate correctly stated two features of the structure of the xylem and included accurate functions. The full four marks were awarded.

Candidate's Response to Part (b) (ii) – Sample 2

(ii) Explain TWO ways in which the structure of the xylem is suited for its role in transpiration.

The xylem is hollow ✓ which allows for ~~the~~ maximum water to be transported and allows for the forces of cohesion and adhesion to facilitate ✓ constant and one way flow of water for the plant. The xylem's walls are lignified ✓ (water proof) which allows for no water to be transported ✗ through its walls.

(4 marks)

Examiner's Comments

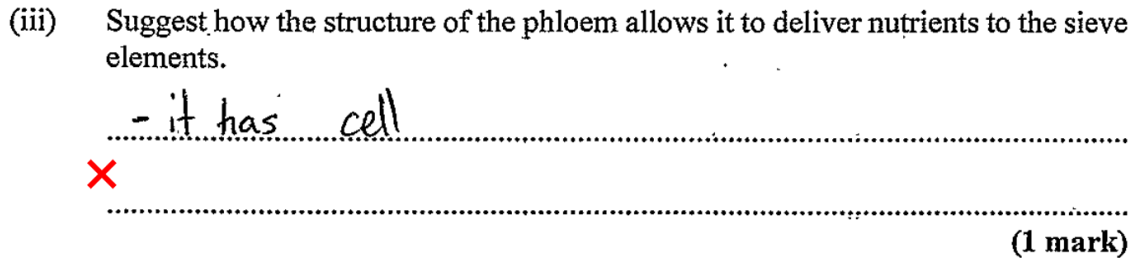
This candidate correctly stated two features of the structure of the xylem but only provided an accurate function of one of the features. Three marks were awarded.

In Part (b) (iii), candidates were required to indicate how the structure of the phloem allows it to deliver nutrients to the sieve elements. Some appropriate answers are given below.

- The presence of companion cells allows for this function.
- The presence of sieve plate/sieve tube plate/partially broken-down end wall allows for the delivery of the nutrients to the sieve elements.

This question was poorly answered. Candidates were seemingly unaware of the existence of the companion cell and/or sieve plate and how they relate to the transport of the nutrients.

Candidate's Response to Part (b) (iii) – Sample 1


(iii) Suggest how the structure of the phloem allows it to deliver nutrients to the sieve elements.

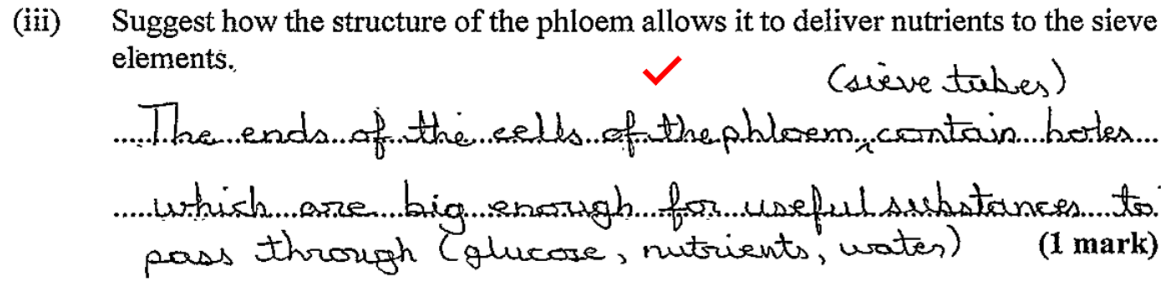
- it has cell

(1 mark)

Examiner's Comments

This candidate's response was inaccurate, so the mark was not awarded.

Candidate's Response to Part (b) (iii) – Sample 2


(iii) Suggest how the structure of the phloem allows it to deliver nutrients to the sieve elements.

(sieve tubes)

The ends of the cells of the phloem, contain holes which are big enough for useful substances to pass through (glucose, nutrients, water) (1 mark)

Examiner's Comments

This candidate identified the correct structure. The mark was awarded.

Candidate's Response to Part (b) (iii) – Sample 3

(iii) Suggest how the structure of the phloem allows it to deliver nutrients to the sieve elements.

The phloem contains companion cells that allows it to perform it function by acting as a brain.

(1 mark)

Examiner's Comments
This candidate identified the correct structure and so, was awarded the mark.

Question 5

For this question, Specific Objectives B 1.6, 3.2 and 3.3 were tested. The question tested candidates' knowledge of diffusion, breathing and respiration. The question further examined the process of gas exchange and the use of anaerobic respiration in humans.

In Part (a), candidates were required to define diffusion, breathing and respiration. Candidates were generally able to provide the definitions, and the majority scored at least two of the three marks for this question. The table below summarizes accepted responses.

Diffusion	The (net) movement of a substance from a region of higher concentration to a region of lower concentration Or The movement of a substance down/along a concentration gradient
Breathing	The process of taking air into the lungs and then expelling it Or The process of taking in oxygen and releasing carbon dioxide Or The process of inhaling and exhaling Or The muscular movement which supplies the respiratory surface with air.
Respiration	The process where energy in food is made available for a cell to do the work necessary to keep it alive.

Common errors noted were the giving of a definition for osmosis instead of diffusion and the giving of a definition for gas exchange instead of breathing.

Candidate's Response to Part (a) – Sample 1

(a) Define the following terms:

Diffusion is the process by which particles move from a region of higher concentration to a region of lower concentration, until evenly distributed

Breathing the movement of oxygen to gaseous exchange surface and the removal of carbon dioxide from the surface. Inhalation and exhalation.

Respiration is the process by which energy is released from food by living organisms.

(3 marks)

Candidate's Response to Part (a) – Sample 2

(a) Define the following terms:

Diffusion Diffusion is the movement of particles or molecules from an ~~an~~ area of high concentration to an area of lower concentration.

Breathing Breathing is the mechanism by which we inhale (take in oxygen from air) and exhale (expel carbon dioxide from the body).

Respiration Respiration is the release of chemical energy from food for use by body cells.

(3 marks)

Examiner's Comments

These two candidates defined each of the terms correctly. Three marks were awarded in each case.

Candidate's Response to Part (a) – Sample 3

(a) Define the following terms:

Diffusion is the movement of particles from its area of high cocentration to its area of lower concentration until evenly distributed.

Breathing is the movement which draws oxygen to site of gaesous exchange surface and carries carbon dioxide away from gaesous exchange surface.

Respiration is the loss of heat produced from metabolic reactions within an organism

(3 marks)

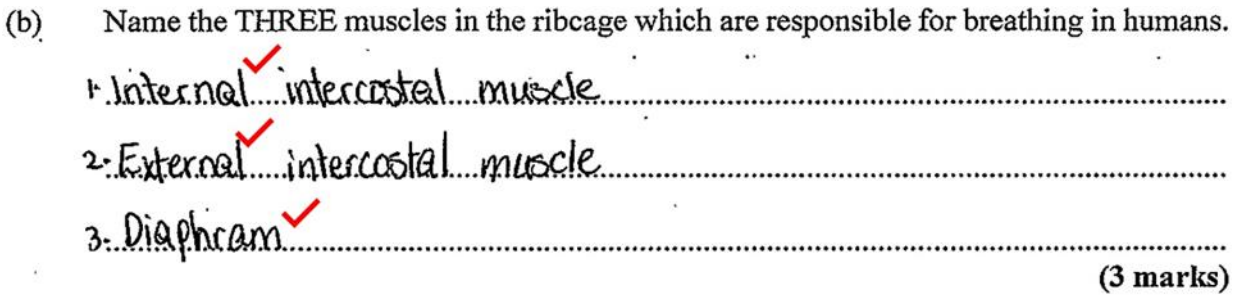
Examiner's Comments

This candidate defined two of the terms correctly. The definition for the term *respiration* was incorrect. The candidate was awarded two of the three marks.

Part (b) required candidates to name the three muscles in the ribcage which are responsible for breathing in humans. The correct answers are *diaphragm*, *Internal intercostal muscles,* and *external intercostal muscles*.

This question was poorly done. Very few candidates scored three out of three. There is the continued occurrence of poor spelling of biological terms. In this instance, candidates had difficulty spelling the words *diaphragm* and *intercostal*.

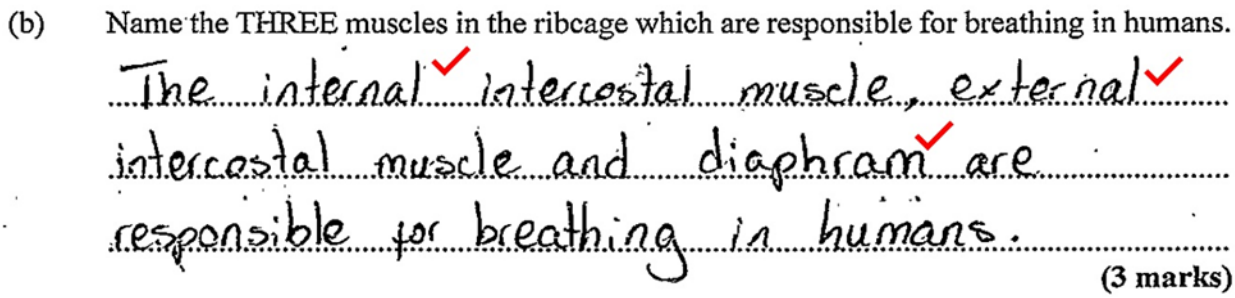
Candidate's Response to Part (b) – Sample 1


(b) Name the THREE muscles in the ribcage which are responsible for breathing in humans.

1. Internal intercostal muscle
2. External intercostal muscle
3. Diaphram

(3 marks)

Candidate's Response to Part (b) – Sample 2


(b) Name the THREE muscles in the ribcage which are responsible for breathing in humans.

The internal intercostal muscle, external intercostal muscle and diaphram are responsible for breathing in humans.

(3 marks)

Examiner's Comments

In the two instances noted above, the candidates named three muscles. The candidates were given the benefit of the doubt regarding the spelling of the third muscle. The three marks were awarded in each case.

Candidate's Response to Part (b) – Sample 3

(b) Name the THREE muscles in the ribcage which are responsible for breathing in humans.

Diaphragm ✓

Internal ✓ intercoastal muscles

External ✓ intercoastal muscles

(3 marks)

Examiner's Comments

This candidate named three muscles. In this case, the candidate was given the benefit of doubt regarding the spelling of the word *intercostal*. The three marks were awarded.

Candidate's Response to Part (b) – Sample 4

(b) Name the THREE muscles in the ribcage which are responsible for breathing in humans.

Intercostal ✓ muscles, diaphragm ✓ muscles and the lungs.

(3 marks)

Examiner's Comments

This candidate named two of the terms correctly. The candidate was given the benefit of doubt regarding the intercostal muscles even though internal and external were not specified. The third part of the answer, 'the lungs' was incorrect. The candidate was awarded two marks.

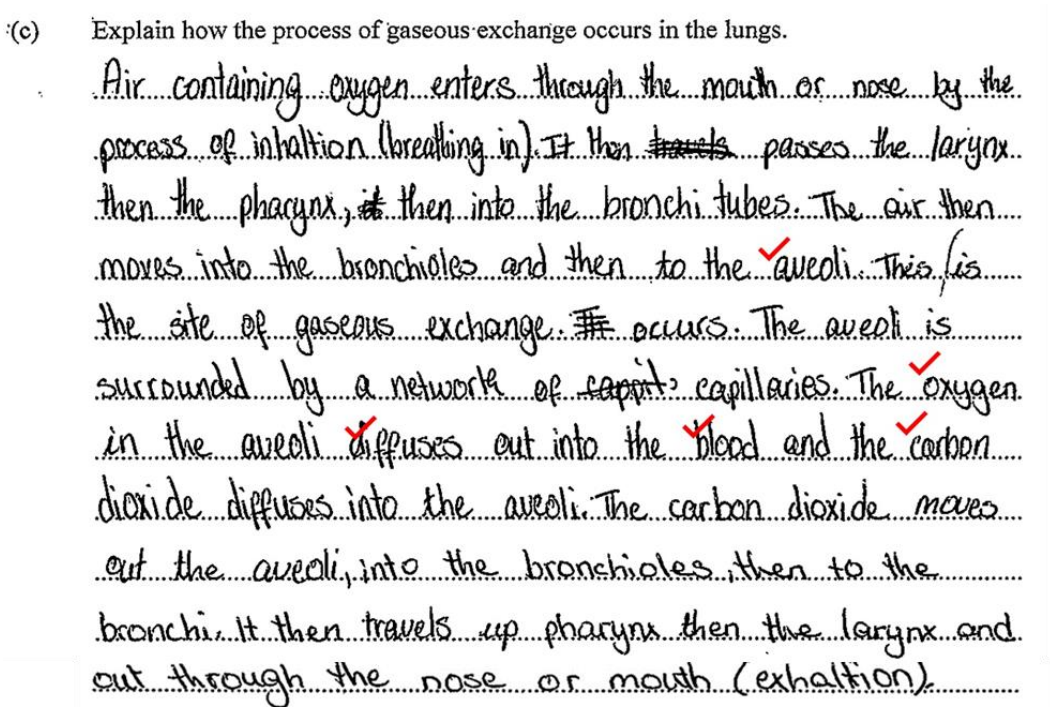
Part (c) required candidates to explain how the process of gaseous exchange occurs in the lungs. It was expected that candidates would explain the following.

> Because there is a higher concentration of oxygen in the alveolus, oxygen is able to diffuse through the thin wall/moist/large surface area of the alveolus (into the capillary network) and enter into the blood. In exchange, carbon dioxide diffuses from the blood into the alveoli where the concentration of carbon dioxide is lower.

This part of the question was moderately done. Several candidates were able to score at least three out of the five marks.

The following samples are given to highlight various ways in which correct answers were expressed.

Candidate's Response to Part (c) – Sample 1


(c) Explain how the process of gaseous exchange occurs in the lungs.

Air containing oxygen enters through the mouth or nose by the process of inhaltion (breathing in). It then ~~travels~~ passes the larynx then the phacynx, ~~it~~ then into the bronchi tubes. The air then moves into the bronchioles and then to the ✓ aveoli. This is the site of gaseous exchange. ~~It~~ occurs. The aveoli is surrounded by a network of ~~capil~~ capillaries. The ✓ oxygen in the aveoli ✓ diffuses out into the ✓ blood and the ✓ carbon dioxide diffuses into the aveoli. The carbon dioxide moves out the aveoli, into the bronchioles, then to the bronchi. It then travels up pharynx then the larynx and out through the nose or mouth (exhaltion).

Candidate's Response to Part (c) – Sample 2

(c) Explain how the process of gaseous exchange occurs in the lungs.

After air enters the body through the nose / mouth and passes down the trachea, it enters the bronchus which branches into bronchioles in the lungs. The many bronchioles end in air sacs called alveoli, which are incredibly numerous in the lungs. They are thin-walled, moist and located close the bloodstream. At the alveoli, oxygen from the air diffuses into the bloodstream because of the bloodstream's lower concentration of oxygen ~~+~~ compared to the alveoli. In turn, carbon dioxide from the bloodstream diffuses into the alveoli and exits the body by the reverse passage of inhalation. Carbon dioxide was at a higher concentration in the bloodstream so it moved (diffused) to the alveoli.

SEEN

SEEN

Candidate's Response to Part (c) – Sample 3

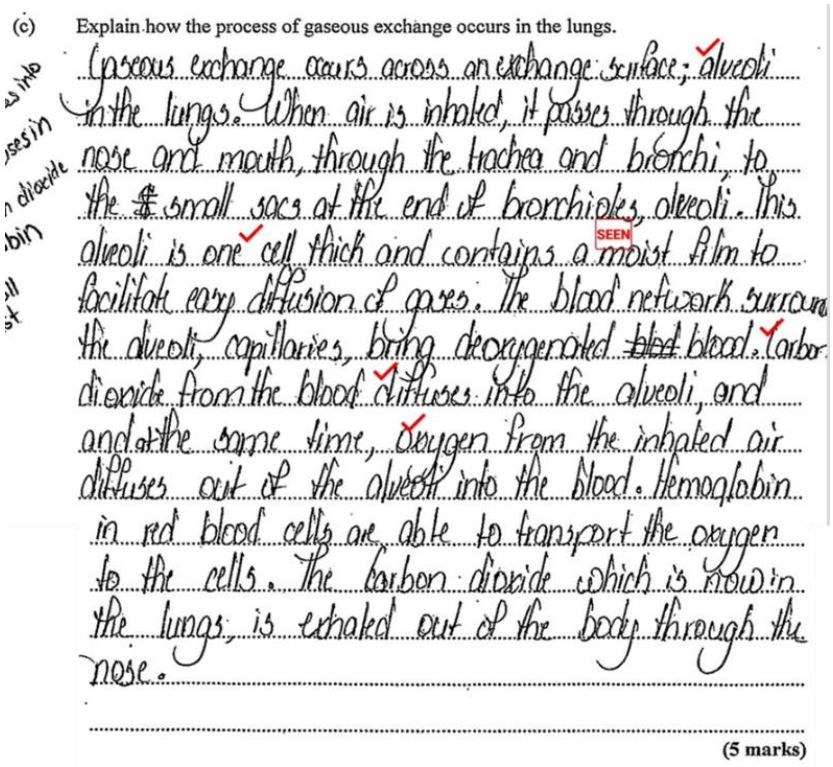
(c) Explain how the process of gaseous exchange occurs in the lungs.

The alveoli, located at the end of bronchioles, has capillaries, carrying deoxygenated blood, surrounding it. Due to the lower concentration of carbon dioxide in the alveoli as compared to the capillaries, carbon dioxide moves into the alveoli via diffusion and as breathing occurs, it is carried out of the body. While this occurs, oxygen, which is breathed in, goes into the alveoli. Because of the higher concentration of oxygen in the alveoli as compared to the capillaries, the oxygen moves into the capillaries via diffusion and is transported around the body. The continual intake of oxygen and expel of carbon dioxide ensures that the process is ongoing.

SEEN

(5 marks)

Candidate's Response to Part (c) – Sample 4



(c) Explain how the process of gaseous exchange occurs in the lungs.

Gaseous exchange occurs across an exchange surface; alveoli in the lungs. When air is inhaled, it passes through the nose and mouth, through the trachea and bronchi, to the small sacs at the end of bronchioles, alveoli. This alveoli is one cell thick and contains a moist film to facilitate easy diffusion of gases. The blood network surrou the alveoli, capillaries, bring deoxygenated ~~blood~~ blood. Carbo dioxide from the blood diffuses into the alveoli, and and at the same time, oxygen from the inhaled air diffuses out of the alveoli into the blood. Hemoglobin in red blood cells are able to transport the oxygen to the cells. The carbon dioxide which is now in the lungs, is exhaled out of the body through the nose.

(5 marks)

Examiner's Comments

These candidates' explanations of the process of gaseous exchange were comprehensive. In each case, the five marks were awarded.

In Part (d), candidates were asked to explain how human beings use anaerobic respiration during exercise. Candidates were expected to explain the following.

> During prolonged/strenuous/vigorous exercise, the oxygen supply becomes inadequate and aerobic respiration stops. Muscle cells would then begin to respire anaerobically where glucose is partially broken down to lactic acid and small amounts of energy. Lactic acid builds up and is toxic, causing pain/fatigue/cramps.

An example of a good response is as shown below.

> During exercise, humans require more energy. To produce energy faster, the body uses anaerobic respiration because oxygen will not be obtained fast enough. Anaerobic respiration also produces a small amount of ATP

(energy release) compared to respiration aerobically. Anaerobic respiration, as it does not require oxygen, makes a product called lactic acid which is toxic and can only be removed when oxygen arrives to cells and bonds with the acid.

$C_6H_{12}O_6 \rightarrow C_3H_6O_3 + CO_2 + ATP$

glucose *lactic acid* *carbon dioxide* *energy release*

Candidates' performance on this part of the question was fair. Several candidates were able to score at least two out of the four marks.

The following samples are given to highlight various ways in which very good answers were expressed.

Candidate's Response to Part (d) – Sample 1

(d) Explain how human beings use anaerobic respiration during exercise.

During strenuous ~~exce~~ exercise, the body is not taking in enough oxygen and can not keep up with the demands of aerobic respiration of the cells. The cells begins to respire anaerobicly (without oxygen). The muscles ~~This causes the~~ would no longer receive enough oxygen and would become fatigese and stop contracting, ~~This is known as an oxygen dept~~ due to the build up of lactic acid. This is known as an oxygen dept. The dept must be repaid by ~~to~~ resting and taking deep breaths. The lactic acid would then diffuse out of muscles and out of the body.

(4 marks)

Examiner's Comments

This candidate's explanation of how a human being uses anaerobic respiration was very good. The full four marks were awarded.

Candidate's Response to Part (d) – Sample 2

(d) Explain how human beings use anaerobic respiration during exercise.

Exercise requires a lot of energy and oxygen. During exercise, it is more difficult to breathe and inhale an adequate amount of oxygen to combine with glucose to produce CO_2 and water. Instead, the cells convert ~~of~~ or breakdown glucose directly into lactic acid. This supplies the muscles with the energy needed for the exercise until it is finished. When finished, the body can respire aerobically again and uses the oxygen to repay the oxygen debt at the muscles.

(4 marks)

Examiner's Comments

This candidate's explanation of how a human being uses anaerobic respiration was very good. The full four marks were awarded.

Candidate's Response to Part (d) – Sample 3

(d) Explain how human beings use anaerobic respiration during exercise.

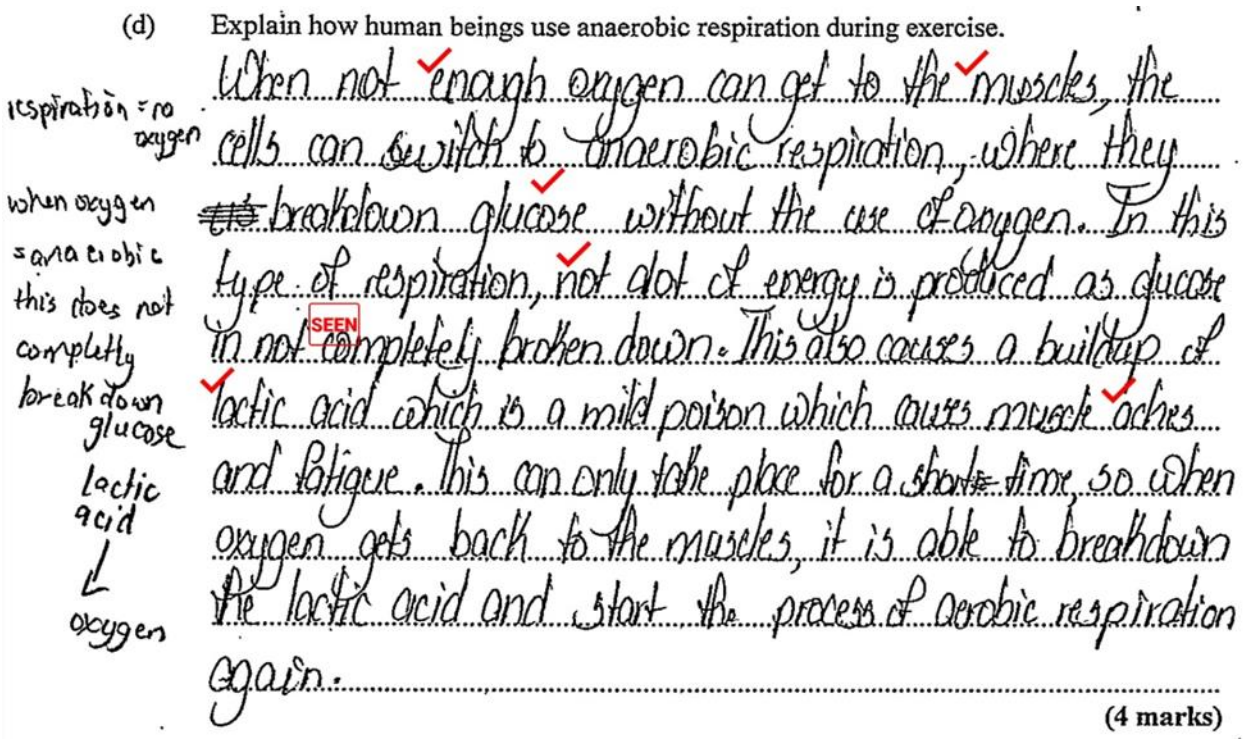
When exercising, the additional work of the muscles require more oxygen but ~~a the as~~ the rate of breathing is too slow to provide the oxygen and so muscle cells begin to respire anaerobically which creates less energy and a build-up of lactic acid. This can be very painful and eventually the muscles stop contracting when in oxygen debt.

(4 marks)

Examiner's Comments

This candidate's explanation of how a human being uses anaerobic respiration was very good. The full four marks were awarded.

Candidate's Response to Part (d) – Sample 4



(d) Explain how human beings use anaerobic respiration during exercise.

respiration = to oxygen

when oxygen = anaerobic this does not completly break down glucose lactic acid ↓ oxygen

When not enough oxygen can get to the muscles, the cells can switch to anaerobic respiration, where they ~~the~~ breakdown glucose without the use of oxygen. In this type of respiration, not alot of energy is produced as glucose is not completely broken down. This also causes a buildup of lactic acid which is a mild poison which cuses muscle aches and fatigue. This can only take place for a short time, so when oxygen gets back to the muscles, it is able to breakdown the lactic acid and start the process of aerobic respiration again.

SEEN

(4 marks)

Examiner's Comments

This candidate's explanation of how a human being uses anaerobic respiration was very good. The full four marks were awarded.

Question 6

This question tested Specific Objectives B5.1, B5.3, B5.4. The question assessed candidates' knowledge of excretion and egestion, and their understanding of osmoregulation as applied to dehydration in humans. Candidates were also required to explain ways that plants conserve water.

In Part (a), candidates were required to define the terms *excretion* and *egestion*. This was well done. Most candidates defined excretion as *the removal of metabolic waste and harmful substances produced by the body*. However, egestion is *the removal of undigested/ insoluble material or food as faeces when no chemical reaction has taken place*. The type of waste/material being removed is the major distinguishing factor between the terms; hence, candidates who simply wrote that "excretion is the removal of waste from the body" were only awarded one mark. A misconception observed was incorrectly defining egestion as digestion or as the consumption and taking in (ingestion) of nutrients.

Candidate's Response to Part (a) – Sample 1

(a) Define the terms 'egestion' and 'excretion'.

egestion is the removal ~~release~~ of undigested food from the body

excretion is the removal of metabolic waste ~~caused~~ (produced ~~created~~ by metabolic reactions) from the body

(2 marks)

Examiner's Comments

This candidate gave a correct definition of the terms, making a clear distinction between the type of waste being removed during egestion and the type of waste being removed during excretion. The candidate was awarded full marks.

Candidate's Response to Part (a) – Sample 2

(a) Define the terms 'egestion' and 'excretion'.

~~Egestion is the intake of food into the mouth~~

Egestion is the removal of fibre, water, salts, (the waste products of digestion), from the body.

Excretion is the removal of ~~metabolic~~ waste from all cells. The waste ~~the met from~~ removed is from the metabolic processes occurring in the body.

(2 marks)

Examiner's Comments

This candidate gave a correct definition of the terms, making a descriptive distinction between the type of waste being removed during egestion and the type of waste being removed during excretion. The candidate was awarded full marks.

For Part (b), most candidates were able to score at least two of the four marks for correctly naming the organs of excretion and linking a substance excreted from each. The correct answers were as follows.

- Skin: Water, urea, salts as sweat (heat/excess heat was accepted)
- Kidneys: Water, nitrogenous waste and salts (urine was accepted)
- Lungs: Carbon dioxide and water (vapour was accepted)
- Liver: Bile pigments

Incorrect organs such as 'colon', 'large intestine', 'anus', 'rectum', 'penis', 'vagina', 'urethra', 'bladder', 'pancreas' and 'nose' were not credited and no marks were awarded if 'faeces' or 'amino acids' were given as examples of excretory substances. However, candidates were able to gain marks for correctly naming substances excreted even if the organ identified was inaccurate.

Candidate's Response to Part (b) – Sample 1

(b) In humans, several organs are responsible for excretion. List TWO organs of excretion and, for EACH organ, state ONE substance which is excreted from it.

Excretory organ Kidney ✓

Substance excreted urea ✓ (nitrogenous waste) metabolic water

Excretory organ Lungs ✓

Substance excreted carbon ✓ dioxide and ~~water~~ metabolic water

(4 marks)

Candidate's Response to Part (b) – Sample 2

(b) In humans, several organs are responsible for excretion. List TWO organs of excretion and, for EACH organ, state ONE substance which is excreted from it.

Excretory organ Kidney ✓

Substance excreted urea ✓

Excretory organ lungs ✓

Substance excreted Carbon dioxide ✓

(4 marks)

Examiner's Comments

These candidates gave correct listings of excretory organs and the associated substances excreted. The full four marks were awarded in each case.

Candidate's Response to Part (b) – Sample 3

(b) In humans, several organs are responsible for excretion. List TWO organs of excretion and, for EACH organ, state ONE substance which is excreted from it.

Excretory organ ~~Skin~~ Kidney ✓

Substance excreted urea ~~in~~ in urine ✓

Excretory organ Skin ✓

Substance excreted sweat (water, salts..) ✓

(4 marks)

Examiner's Comments

This candidate also gave a correct listing of the excretory organs and the associated substances excreted. The full four marks were awarded.

In Part c (i), candidates were given the following situation.

> Joy is ill and is vomiting a lot during the day. She becomes very dehydrated as a result of her condition because she has lost a large volume of fluid.

Candidates were asked to explain the role of the kidneys in correcting Joy's fluid imbalance. Some candidates were able to adequately describe the steps in osmoregulation. However, most candidates struggled to identify the function of the kidney in correcting a fluid imbalance. There was difficulty in linking dehydration to a change in blood concentration. Marks were awarded if candidates explained any of the four points highlighted below.

- The kidney will do any one of the following.
  - Correct the high concentration of solute in the blood.
  - Maintain (homeostasis) via a process called osmoregulation.
  - Regulate the concentration of body fluids during selective reabsorption.
- Due to vomiting which means there is loss of fluid (water), blood becomes concentrated with solutes/ water levels in blood are low.
- The hypothalamus in the brain detects the blood concentration.
- The pituitary gland will respond by secreting antidiuretic hormone (ADH) into the blood.
- ADH stimulates the kidney to reabsorb most of the water from the filtrate
  Or
  ADH stimulates the kidneys to conserve water.
- Small amounts/concentrated urine will be produced, that is, less water is excreted.

Many candidates' responses illustrated some misconceptions, including the following.

- That kidneys store water/have stored water that can then be released
- That kidneys secrete ADH
- That the kidneys signal the brain
- That the kidneys filter water (Note that the word 'filter' was not acceptable as it is not part of the osmoregulatory function of the kidney.)

Candidate's Response to Part (c) (i) – Sample 1

(i) Joy is ill and is vomiting a lot during the day. She becomes very dehydrated as a result of her condition because she has lost a large volume of fluid. Explain the role of the kidneys in correcting Joy's fluid imbalance.

The brain detects the concentration of fluid, the pituitary gland then secretes anti-diuretic hormone which makes the walls of the distal convoluted and collecting duct tubule to become more permeable thus allowing more water the be reabsorbed via which is during SELECTIVE REABSORBTION ~~the~~ takes place there. The body only would release small concentrations of urine due to this process which is called osmoregulation

The kidneys are responsible for maintaining body fluid balance through-out the body and remove waste and it is stated above how the kidneys would correct Joys fluid imbalance **(4 marks)**

Examiner's Comments

This candidate was able to score the four marks for correctly describing the sequence of events. Some of the noted key points are that

- the pituitary gland secretes anti-diuretic hormone
- more water was reabsorbed due to the ADH acting on the d.c.t and c.d. making them more permeable
- the body would only release small concentration of urine.

The candidate also correctly provided the name of the process — osmoregulation.

Candidate's Response to Part (c) (i) – Sample 2

(i) Joy is ill and is vomiting a lot during the day. She becomes very dehydrated as a result of her condition because she has lost a large volume of fluid. Explain the role of the kidneys in correcting Joy's fluid imbalance.

When the blood osmotic potential drops too low, this is detected by the hypothalamus which tells the pituitary gland to secrete more ADH. The ADH travels via the blood to the kidneys. The ADH stimulates the cells of the distal convoluted tubule and collecting duct to pick up more water from the filtrate. Thus, more water is returned to the blood and less is lost to the urine. SEEN

(4 marks)

Examiner's Comments

This candidate went straight into the explanation and did so in the correct sequence. The candidate also obtained the full four marks.

Candidate's Response to Part (c) (i) – Sample 3

(i) Joy is ill and is vomiting a lot during the day. She becomes very dehydrated as a result of her condition because she has lost a large volume of fluid. Explain the role of the kidneys in correcting Joy's fluid imbalance.

As Joy is dehydrated due to the lost fluid, her blood plasma would be concentrated. It would have a higher concentration of dissolved substances than water. As the hypothalamus detects the solute concentration of blood, it would send a signal to the pituitary gland to secrete larger amounts of ADH. The blood with the ADH flows to the kidney via the renal artery and enters the kidney. As the ~~blood enters all with~~ the small ~~enough~~ substances ~~to~~ that diffused into the Bowman's capsule along with the ADH, ~~enter~~ pass along the nephrons in the kidneys, the ADH sends signals to the collecting duct and ~~or~~ distal convoluted tubule to increase the permeability of their walls so that more water is reabsorbed back into the blood. This increases the water to solute ratio in the blood to correct the fluid imbalance. **(4 marks)**

Examiner's Comments

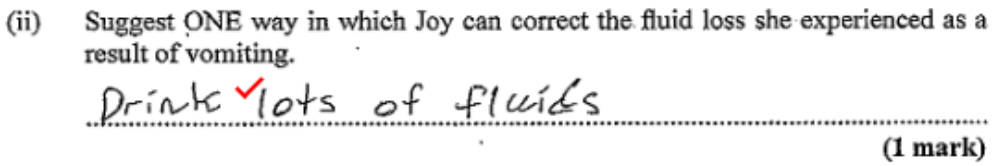
This was a very thorough explanation of how the fluid imbalance is corrected. The candidate gained full marks.

In Part c (ii), most candidates were able to score one mark for correctly suggesting how to correct the fluid loss experienced as a result of vomiting. The following are some of the acceptable responses.

- Drink more water/rehydration salts or solution.
- Drink Gatorade/Powerade/fluids/electrolytes.
- Get IV saline solution/drips.

Answers such as 'eating more food, vegetables or protein' were not awarded any marks. Candidates who simply stated 'getting medication' or 'going to the doctor' were also not awarded any marks.

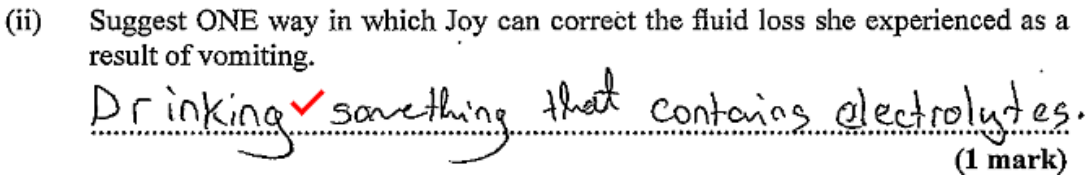
Candidate's Response to Part (c) (ii) – Sample 1



Examiner's Comments

This candidate's statement is general and correct. The mark was awarded even though the word 'fluids' could have been further described.

Candidate's Response to Part (c) (ii) – Sample 2



Examiner's Comments

This candidate was easily awarded the mark since the response indicated the substance that should be in the liquid/fluid Joy needed to use to correct the fluid loss she was experiencing.

Candidate's Response to Part (c) (ii) – Sample 3

(ii) Suggest ONE way in which Joy can correct the fluid loss she experienced as a result of vomiting.

Drinking lots of water ✓ and fluid.

(1 mark)

Candidate's Response to Part (c) (ii) – Sample 4

(ii) Suggest ONE way in which Joy can correct the fluid loss she experienced as a result of vomiting.

She can drink ✓ more water.

(1 mark)

Candidate's Response to Part (c) (ii) – Sample 5

(ii) Suggest ONE way in which Joy can correct the fluid loss she experienced as a result of vomiting.

Joy can rehydrate by increasing her water ✓ intake for a few days.

(1 mark)

Examiner's Comments

These last three candidates each noted the type of liquid they were suggesting Joy could use (water). Each of these candidates gained the mark.

Part (d) required candidates to explain two ways in which plants conserve water. Most candidates were able to score at least one mark. The most popular methods given were *the closure of stomata*, *thickened waxy cuticles on leaves* and *storage of water in stems or leaves*. While some candidates were able to provide adequate explanations along with these methods, most candidates were unable to do so.

Acceptable responses had to include identifying two ways plants conserve water (methods) and providing explanations for how the methods help/work. Examples are as follows.

Method	Explanation
Closure of stomata	Reduces water vapour that is lost from leaves / that is lost during transpiration
Thickened waxy cuticles on the epidermis of the leaf	Reduces water loss
Storage of water in stems/leaves	The stored water can be used when needed, for example, in hot climates or when the temperature changes, like during times of drought. (Note how the cacti and aloe plants adapt.)
Stomata in sunken pits/pores	The sunken state allows water vapour to build up around the stomata causing saturated air which reduces the transpiration rate.
Reduced leaf area through wilting Thinning of branches Reduced stomata numbers Shedding of leaves	Transpiration takes place from the leaves of plants. Therefore, if leaf area/surface area is reduced, then transpiration/water loss is reduced.
Rolled leaves Hairs on leaves	Leaves have hair and leaves also roll when water is in short supply. The stomata located inside the roll or within the hair causes water vapour to become trapped, thus reducing water loss.
Increase in root length/spread	Deep roots can reach far down into the soil to reach the water table so that any water that is present in the soil can be absorbed.

Misconceptions about water storage in plants were that 'xylems store water' and 'plants make the soil store more water'. Also, responses which gave the explanation that 'leaves let water fall on to the soil so roots can reabsorb water', and 'leaves act as a mulch and therefore helps the plant conserve water' were not awarded marks.

Candidate's Response to Part (d) – Sample 1

(d) Explain TWO ways in which plants conserve water.

Plants ~~leaves~~ leafs close their stomata in the day and open them at night to reduce transpiration due to high temperatures and light intensity in the day which increases the rate of transpiration. Plants also grow tiny hairs on their leafs in order to trap water vapour and allow for a high humidity around the leafs. they do this so that they can lower the rate of transpiration due to the fact that a high humidity decreases the rate of ~~transp~~ transpiration.

(4 marks)

Examiner's Comments

This candidate provided two good explanations of how plants conserve water and was awarded the full four marks.

Candidate's Response to Part (d) – Sample 2

(d) Explain TWO ways in which plants conserve water.

Plants can close their stomata which allows less water to be lost via transpiration.

Plants can also curl their leaves which creates a pocket of humidity and thus, reducing water lost by transpiration as there is a very small diffusion gradient.

Examiner's Comments

The candidate provided correct explanations of two different ways plants conserve water. The candidate was awarded the four marks.

Candidate's Response to Part (d) – Sample 3

(d) Explain TWO ways in which plants conserve water.

① There is a thick waxy ✓cuticle on the surface of the leaf which is waterproof to prevent evaporation ✓ of water.

② when the ~~wa~~ plant is low on water, the ~~four~~ guard cells of the plant close ✓the stomata to prevent ✓water loss via evaporate as the leaves get flaccid. This prevents water ~~lost~~ loss via transpiration, hence water is conserved and remains in plant.

Examiner's Comments

The two ways plants conserve water were well explained. The candidate was therefore awarded the full four marks.

Candidate's Response to Part (d) – Sample 4

(d) Explain TWO ways in which plants conserve water.

Stomata pores are surrounded by a pair of guard cells. These cells can close ✓ the stomata pores to ensure that water does not ✓ evaporate from them and some plants have ~~thin~~ small ✓ needle-like ~~leaf~~ leaves with a small surface area so that the rate of transpiration ✓ is slow.

Examiner's Comments

This candidate was able to provide a succinct answer with correct explanations of the two ways plants conserve water. The full four marks were awarded.

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

The mean score for Paper 032 was 16.51 in 2023, compared to 21.39 in 2022 and 17.84 in 2021.

Question 1

This question tested Specific Objectives B 9.7 and 9.11. For this question, candidates were required to observe two specimens and make suitable deductions. Additionally, the question tested the parts of the flower and their related functions.

For Part (a), candidates were provided with two specimens, X and Y, and were asked to observe each carefully and then dissect the specimens longitudinally to view the internal structures. Candidates then had to complete Table 1 which required them to observe the external and internal structures of both fruits.

Many candidates were able to complete this activity satisfactorily. Supervisors at centres where there was no *Cajanus cajan* (pigeon pea), made appropriate substitutions and candidates were marked accordingly. No candidate was disadvantaged as a result of the substitutions made.

In Part (b), candidates were asked to state the most likely method of dispersal of Specimen X.

Most candidates were able to gain this mark.

Part (c) required candidates to make a large drawing of Specimen Y and place an 'A' to indicate the scar where the fruit was attached to the parent plant and a 'B' to indicate the scar where the style was attached to the ovary.

Most candidates did not know the correct placement of the scar where the style was attached to the ovary, so only the more competent candidates received all five marks for this question. One mark was awarded for each of the following.

- Providing the large drawing
- Proportioning the drawing correctly
- Using smooth, continuous lines
- Placing the 'A' correctly
- Placing the 'B' correctly

For Part (d), candidates were asked to suggest a suitable title for the practical.

Many candidates were able to earn the mark. An acceptable title was *Comparing the Structure of Two Different Fruits*.

In Part (e) (i), candidates were given a longitudinal section of a typical flower and were asked to outline one way in which the structure labelled A (a petal) is adapted to its function.

This part was well done. Acceptable answers were as follows.

- It is large/conspicuous, so it is easily seen by insects/pollinators.
- It is brightly coloured, so insects and birds are attracted to the flower for nectar.
- It is scented, so insects and birds are attracted, effecting pollination.
- It has pollen guides/nectar guides which guide insects to the nectaries.
- It protects the reproductive organs of the flower while they are being developed.
- The size and shape aids in the protection of the inner structures.

Part (e) (ii) required candidates to explain how the structures labelled B and D function together to initiate the development of seeds.

This part was poorly done as many candidates did not seem to know the identity of the structures labelled B (anther) and D (stigma). Some of them seemed to be confused and used the names of the two structures interchangeably. Any two of the following three points would have been acceptable.

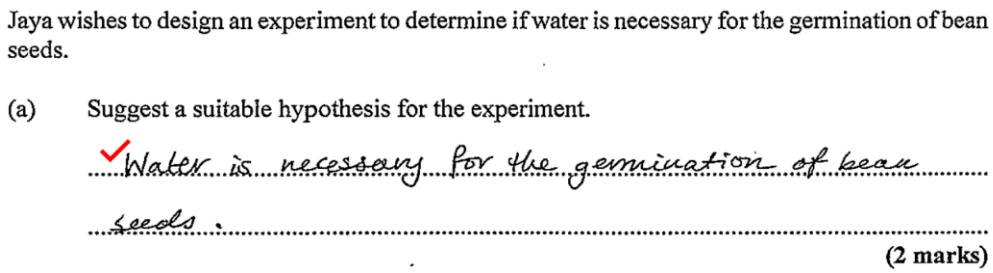
- B (anther) produces pollen grains containing male gametes.
- D (stigma) catches the pollen grains.
- The male nuclei of the pollen grains then migrate down the style to the ovule (in the ovary).

Question 2

This question tested Specific Objectives B8.1, 8.3. In this question, candidates were required to make deductions from a simple investigation designed to demonstrate growth in plants. Candidates were also asked to describe the process taking place within a seed during germination.

In Part (a), candidates were required to state a suitable hypothesis for the experiment for which a brief description was given. Some candidates were able to score two marks by stating the correct hypothesis, for example, *water is necessary for germination*. However, some incorrectly stated the hypothesis as an aim.

Candidate's Response to Part (a) – Sample 1


Jaya wishes to design an experiment to determine if water is necessary for the germination of bean seeds.

(a) Suggest a suitable hypothesis for the experiment.

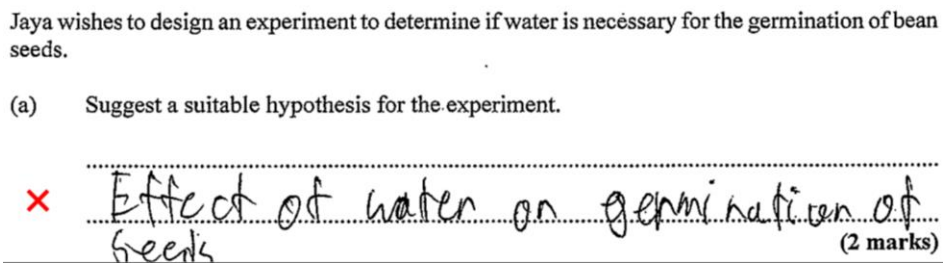
✓ Water is necessary for the germination of bean seeds.

(2 marks)

Examiner's Comments

This candidate submitted a well-written hypothesis. The two marks were awarded.

Candidate's Response to Part (a) – Sample 2


Jaya wishes to design an experiment to determine if water is necessary for the germination of bean seeds.

(a) Suggest a suitable hypothesis for the experiment.

✗ Effect of water on germination of seeds

(2 marks)

Examiner's Comments

This candidate's response was poor as it was not written as a hypothesis. No marks were awarded.

Candidate's Response to Part (a) – Sample 3

Jaya wishes to design an experiment to determine if water is necessary for the germination of bean seeds.

(a) Suggest a suitable hypothesis for the experiment.

A suitable hypothesis would be: 'Water would be ~~is~~ necessary for the germination of bean seeds.'

Examiner's Comments

This candidate provided an adequately phrased hypothesis. The two marks were awarded.

In Part (b), candidates were given a list of materials and equipment and were required to design a procedure, using all the materials and equipment, which would test the hypothesis given in Part (a). An example of an appropriate procedure is shown below.

1. Label the Petri dishes.
2. Place filter paper into each dish.
3. Fully moisten one of the pieces of filter paper with distilled water.
4. Leave the other filter paper dry.
5. Place ten bean seeds in each petri dish.
6. Set the timer or note the time on the clock.
7. Leave the seeds for 48 hours (or a suitable time for example 2–7 days)
8. Count the number of seeds that have germinated and record the data.
9. Repeat the experiment.

Many candidates were awarded at least three marks. However, it should be noted that many of the candidates displayed misconceptions by doing the following.

- Indicating to put or pour water into both Petri dishes
- Indicating to pour water into the Petri dishes without the use or inclusion of the filter paper
- Indicating that the experiment should be left for an inappropriate length of time, for example, some candidates wrote 'leave for two hours'.
- Simply stating 'take or record observations'

Candidate's Response to Part (b) – Sample 1

(b) Write a suitable procedure which uses all of the materials and equipment in the following list to test the hypothesis stated in (a).

Equipment and Materials

- 20 bean seeds
- 2 Petri dishes
- 2 filter papers
- Distilled water
- Clock

~~Place 10 bean seeds in each Pour distilled water into each petri dish and lay a sheet of filter paper on top. Then put 10 bean seeds into each dish and use the clock to time.~~

Place distilled water into one of the petri dishes and line it with a sheet of filter paper. Place a lone sheet of filter paper into the second dish. Split the bean seeds into two and place 10 into each petri dish. Set the clock for about 5-10 days and observe if germination occured in any of the dishes.

Examiner's Comments

This candidate provided a well-written procedure. It could have been improved by indicating that the petri dishes were labelled and that the experiment should be repeated. The candidate was awarded five of the six marks.

Candidate's Response to Part (b) – Sample 2

(b) Write a suitable procedure which uses all of the materials and equipment in the following list to test the hypothesis stated in (a).

Equipment and Materials

- 20 bean seeds
- 2 Petri dishes
- 2 filter papers
- Distilled water
- Clock

- Place filter paper in Petri dish labelled a.
- Place damp filter paper in petri dish labelled b.
- Place 10 bean seeds in each petri dish.
- Measure the mass of each petri dish over a ~~week~~ week.

Examiner's Comments

This candidate submitted an incomplete procedure. Four of the six marks were awarded.

Candidate's Response to Part (b) – Sample 3

(b) Write a suitable procedure which uses all of the materials and equipment in the following list to test the hypothesis stated in (a).

Equipment and Materials

- 20 bean seeds
- 2 Petri dishes
- 2 filter papers
- Distilled water
- Clock

Place ten beans in one of the petri dishes and another ten beans in the other petri dish and label both petri dishes. Both sets of beans should be resting on filter paper used to line the bottom of each Petri dish (one sheet of paper per dish). In one of the dishes only, add distilled water until the filter paper is completely soaked. Remember or record which dish it was. Using the clock, wait twenty four hours and return, as there is no need to be in the room the entire time. Make observations and record. Repeat if necessary for a maximum of seventy-two hours at any time. Should the filter paper become dry, small amounts of distilled water can be added until the paper becomes moist once more. Ensure this only applies to the petri dish that ~~was wet~~ contained the sample of wet beans only.

Examiner's Comments

This candidate gave a well-written procedure which was accurately outlined and used all the equipment provided. The full six marks were awarded.

Candidate's Response to Part (b) – Sample 4

(b) Write a suitable procedure which uses all of the materials and equipment in the following list to test the hypothesis stated in (a).

Equipment and Materials

- 20 bean seeds
- 2 Petri dishes
- 2 filter papers
- Distilled water
- Clock

1. Place a filter paper on the bottom of each of the 2 petri dishes.
2. Label one petri dish "A" and the other petri dish "B".
3. Place 10 bean seeds in petri dish A and 10 bean seeds in petri dish B.
4. Measure an appropriate amount of distilled water in a measuring cylinder and pour it in petri dish A only.
5. Record the time using the clock from after the bean seeds were watered and record any changes in growth everyday over a 2 week period, while ensuring the bean seeds from petri dish A are watered daily.

Examiner's Comments

This candidate submitted a well-written procedure which was accurately outlined and provided for the use of all the equipment listed. However, the procedure could have been improved by stating that the experiment should be repeated. Additionally, when the candidate indicated that the seeds should be observed daily after they were watered, a specific adequate time frame should have been given. Five marks were awarded.

In Part (c), candidates were required to provide an appropriate conclusion for the experiment they designed. Examples of appropriate responses are given below.

- The bean seeds exposed to water germinated.
- The bean seeds not exposed to water did not germinate.

Several candidates were able to score marks for this section. Candidates were able to state the correct conclusion once they had stated the hypothesis correctly. However, some candidates incorrectly mistook germination for the growth of seedlings.

Candidate's Response to Part (c) – Sample 1

(c) Write a suitable conclusion for the experiment.

Germination was seen within the bean seeds that were treated with water and those without water did not germinate.

Candidate's Response to Part (c) – Sample 2

(c) Write a suitable conclusion for the experiment.

The bean seeds in Petri dish a remained the same while dish b saw the germination of its bean seeds. ✓

Candidate's Response to Part (c) – Sample 3

(c) Write a suitable conclusion for the experiment.

A suitable conclusion would be: 'Water is necessary for the germination of bean seeds.' ✓

Examiner's Comments

These candidates gave well-written conclusions and each received the full two marks.

For Part (d), candidates were required to state two precautions for the experiment. Many candidates were able to get at least one out of the two marks allotted. Appropriate responses included the following.

- Ensure that all other variables/environmental conditions remain the same for both batches of seeds, for example, same exposure to oxygen and light; same temperature.
- Ensure that the damp filter paper remains damp.
- Ensure that the dry filter paper remains dry.
- Avoid using excess water/measure the water accurately.
- Ensure that the seeds are pest free.
- Ensure that the seeds are disease free.
- Ensure that the seeds are not damaged.
- Make sure that the treatment time is consistent with both batches.
- Ensure that the seeds are of the same variety.
- Ensure that the seeds are fresh/viable.

Common errors are given below.

- Failure to indicate that both sets should be exposed to the same conditions
- Failure to indicate that the experiment should be set up and left for some time
- Indicating that light must be present

Candidate's Response to Part (d) – Sample 1

(d) State TWO precautions that Jaya should take during the experiment.

- Ensure that all beans seeds were kept in the same conditions.

~~- Ensure an equal amount of water was given to both batches of seeds.~~

(2 marks)

- Ensure that an equal, exact amount of time was given to both batches.

Examiner's Comments

This candidate stated two accurate precautions and was awarded the two marks.

Candidate's Response to Part (d) – Sample 2

(d) State TWO precautions that Jaya should take during the experiment.

Ensure both dishes are at similar temperature.
Place both dishes in sunlight.

(2 marks)

Examiner's Comments

This candidate only correctly identified one precaution and was therefore awarded one out of two marks.

Candidate's Response to Part (d) – Sample 3

(d) State TWO precautions that Jaya should take during the experiment.

1. Jaya must ensure that she gives the bean seeds in petri dish A the same amounts of water everyday.
2. Jaya must ensure all other factor that can affect growth remain constant such as temperature and oxygen.

(2 marks)

Examiner's Comments

Only one out of the two marks was awarded for this response.

For the experiment to work, it is not required that the seeds be watered daily. In fact, watering daily introduces the chance of waterlogging the seeds.

In Part (e) (i), candidates were given a scenario where ten seeds were planted and the changes in dry mass were observed. Candidates were then required to indicate why the dry mass was recorded instead of the wet mass. The following are examples of appropriate responses.

- The wet mass fluctuates constantly as the plant receives and loses water at different times of the day.
- The dry mass is more constant/there will be no fluctuations in mass due to changes in water intake or losses.
- The dry mass is more accurate/is a better determination of the change in mass.

This question was poorly answered. A few candidates indicated that observing the dry mass is more accurate and were awarded at least one mark. Based on the responses given, most candidates did not know that wet mass fluctuates constantly. Several candidates did not provide any response to this question.

Candidate's Response to Part (e) (i) – Sample 1

(e) For a second experiment, Jaya planted ten seeds and observed the changes in dry mass over 60 days as the seeds grew into plants.

(i) Explain why Jaya measured the dry mass rather than the wet mass.

Dry mass was measured instead of wet mass because it is far more accurate as it shows the mass without water content which different to differs between plants and at different times due to conditions.

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Examiner's Comments

This candidate gave an incomplete explanation and was awarded two out of the three marks allotted for the question.

Candidate's Response to Part (e) (i) – Sample 2

(e) For a second experiment, Jaya planted ten seeds and observed the changes in dry mass over 60 days as the seeds grew into plants.

(i) Explain why Jaya measured the dry mass rather than the wet mass.

While the seeds are dry their growth ~~stagnates~~ stagnates and water in the petri dish can slightly affect their mass. ×

Examiner's Comments

This candidate's response was inaccurate, so the candidate received zero.

Candidate's Response to Part (e) (i) – Sample 3

(e) For a second experiment, Jaya planted ten seeds and observed the changes in dry mass over 60 days as the seeds grew into plants.

(i) Explain why Jaya measured the dry mass rather than the wet mass.

She did this so that the water content, which can vary, ✓would impact the true mass of the plant tissue. This water content would lead to ✓inaccurate results.

Examiner's Comments

This was a well-written explanation. The candidate was awarded the full three marks.

Candidate's Response to Part (e) (i) – Sample 4

(e) For a second experiment, Jaya planted ten seeds and observed the changes in dry mass over 60 days as the seeds grew into plants.

(i) Explain why Jaya measured the dry mass rather than the wet mass.

The dry mass gives a more accurate reading than the wet mass as the water from the organism is removed dry. The wet mass of an organism at a certain time can vary because the amount of water in the organism can vary as well.

Candidate's Response to Part (e) (i) – Sample 5

(e) For a second experiment, Jaya planted ten seeds and observed the changes in dry mass over 60 days as the seeds grew into plants.

(i) Explain why Jaya measured the dry mass rather than the wet mass.

Dry mass is the mass of an organism without water. Water mass is not accurate when measuring growth as water changes frequently due to drinking, excretion etc. Dry mass only weighs and records the changes in physical structure's weights. It is a more accurate measurement of growth.

Examiner's Comments

These last two candidates submitted incomplete explanations and were each awarded two out of the three marks allotted to the question.

In Part (e) (ii), candidates were required to indicate two pieces of equipment which may have been used to obtain the dry mass of the plants. Examples of acceptable responses included the following.

- Oven
- Desiccator
- Scale/Balance

Many candidates were unable to name two pieces of equipment suitable for obtaining the dry mass of the plants. This suggests a lack of exposure to these types of experiments. Common inappropriate responses included the following.

- Measuring tape
- Shovel
- Clock
- Fork

Candidate's Response to Part (e) (ii) – Sample 1

(ii) Suggest the two pieces of equipment that Jaya may have used to obtain the dry mass of the plants.

Jaya may have used an oven and a scale.

Candidate's Response to Part (e) (ii) – Sample 2

(ii) Suggest the two pieces of equipment that Jaya may have used to obtain the dry mass of the plants.

A scale ✓ and forceps ✓.

Candidate's Response to Part (e) (ii) – Sample 3

(ii) Suggest the two pieces of equipment that Jaya may have used to obtain the dry mass of the plants.

An electronic balance ✓ as well as an oven is needed ✓ to obtain the dry mass.

Examiner's Comments

These three candidates accurately identified two required pieces of equipment and were each awarded the two marks.

Candidate's Response to Part (e) (ii) – Sample 4

(ii) Suggest the two pieces of equipment that Jaya may have used to obtain the dry mass of the plants.

Two pieces of equipment she would have used are, a balance ~~a scale~~ and a plastic sheet.

Examiner's Comments

This candidate accurately identified one required piece of equipment and so, was awarded one mark.

In Part (f) (i), candidates were given a graph and were required to describe how the dry mass of the plants changed over the 40-day period. An example of an appropriate response is shown below.

> Between Days 0 and 5, there is a decline in the dry mass of the plant. Between Days 5 and 25, there is a gradual increase in the dry mass. The mass remains relatively constant between Days 25 and 35. The dry mass starts to decline after day 35.

This section was poorly answered. Additionally, many candidates did not respond. Most candidates seemed unable to read the graph properly and quoted incorrect values. Candidates failed to identify the correct periods of increase and decrease, and the periods where the mass remained constant. Some candidates misinterpreted the question and tried to explain why the mass changes. Such candidates could not be awarded any marks.

Candidate's Response to Part (f) (i) – Sample 1

(i) Based on the shape of the graph in Figure 1, describe how the dry mass of the plants changes over the 40 days.

Over the course of the first 5 days the dry mass significantly decreased however after there was a steady incline until around the 25th day when the mass was at a stand still. At around 35 days it began to ~~increase~~ decrease. **(3 marks)**

Examiner's Comments

This candidate's response provided a full description of the indicated period. The full three marks were awarded.

Candidate's Response to Part (f) (i) – Sample 2

(i) Based on the shape of the graph in Figure 1, describe how the dry mass of the plants changes over the 40 days.

At 0-10 days the ~~peas~~ plants began absorbing water, ~~the~~ Days 10-25 see steady continuous ~~growth~~ increase in mass. At days 25-40 their ~~growth~~ mass stagnates. **(3 marks)**

Examiner's Comments

This candidate's response did not provide a full description of the indicated period. Only one mark was awarded.

Candidate's Response to Part (f) (i) – Sample 3

(i) Based on the shape of the graph in Figure 1, describe how the dry mass of the plants changes over the 40 days.

The dry mass ~~increase~~ decreased after approximately 5 days, after which it drastically increased, peaking at approximately 30 days, where after it ~~sta~~ began slowly decreasing slightly.

Candidate's Response to Part (f) (i) – Sample 4

(i) Based on the shape of the graph in Figure 1, describe how the dry mass of the plants changes over the 40 days.

from day 0 to 5 the dry mass decreases as the bean seed uses up its food store for respiration and growth. from day 5 to 25 as the bean grows leaves and is able to make its own food it grows and increases in mass. After day 25 growth slows rapidly decreases as the maximum growth of the seed is reached. **(3 marks)**

Candidate's Response to Part (f) (i) – Sample 5

(i) Based on the shape of the graph in Figure 1, describe how the dry mass of the plants changes over the 40 days.

From days 0-5, the dry mass decreases from 5grams to 0 grams. From day 5, the mass steadily increases from 0grams to 44 grams at day 23. From day 23, the mass plateaus only to start decreasing again at day 35.

(3 marks)

Examiner's Comments

These last three candidates provided full descriptions of the indicated period. Each of them was awarded the full three marks.

In Part (f) (ii), candidates were required to account for the shape of the graph over the first ten days. Examples of appropriate responses are given below.

- Respiration is increasing and the starch (energy) stored in cotyledons is being used so mass decreases initially**.** Thereafter, the seedling can expose the first leaves to sunlight for photosynthesis and the mass increases.
- The plant used stored food initially so the mass decreases; it increases when the plant can make its own food.

This section was very poorly done; most candidates did not score any marks. It was apparent that many candidates did not know what the word 'account' meant, and as such, candidates described the shape of the graph. Many candidates did not respond to this question.

Candidate's Response to Part (f) (ii) – Sample 1

(ii) Account for the shape of the graph over the first ten days (Day 1 to Day 10).

The graph decreased ~~from~~ until day 5 because the plant was germinating and used up its nutrients for growth Then after those five days the growth was seen and the plant increased in dry mass again.

(2 marks)

Examiner's Comments

This candidate's response vague and required greater detail. Only one mark was awarded.

Candidate's Response to Part (f) (ii) – Sample 2

(ii) Account for the shape of the graph over the first ten days (Day 1 to Day 10).

The plants has seen a decline in their mass in the first 5 days, then regained that mass going onto day 10.

(2 marks)

Examiner's Comments

This candidate's response was a description of the changes over the period and not an explanation as required. No marks were awarded.

Candidate's Response to Part (f) (ii) – Sample 3

(ii) Account for the shape of the graph over the first ten days (Day 1 to Day 10).

Between day 1 and 5, the plant used nutrition from the seed to begin developing roots and leaves. When it developed these features and presumably broke through the soil surface, it began photosynthesizing and rapidly developing, thus increasing dry mass.

(2 marks)

Candidate's Response to Part (f) (ii) – Sample 4

(ii) Account for the shape of the graph over the first ten days (Day 1 to Day 10).

food is used up from the food store or the cotyledon as the bean seed begins to germinate because it is used for respiration and growth. When leaves are finally produced the dry mass increases ~~again~~ as it can now make its own food and further grow.

(2 marks)

Candidate's Response to Part (f) (ii) – Sample 5

(ii) Account for the shape of the graph over the first ten days (Day 1 to Day 10).

From day 1, the seedling is using and getting energy from its cotyledons. It continuously depletes that food store, accounting for the loss of mass. However, from day 5, the plant has gained leaves for photosynthesis and is capable of making its own food for growth. This accounts for the increase in mass. **(2 marks)**

Examiner's Comments

The responses from these last three candidates demonstrates accurate explanations of the changes over the period. In each case, the two marks were awarded.

Question 3

This question tested Specific Objective B4.3. The question assessed candidates' knowledge of the circulatory system. Additionally, it tested candidates' ability to draw a graph, infer trends and relate biological theory to explain the trends.

For this question, candidates were provided with information about Jack who used a heart-rate monitoring application on his cell phone to obtain heart-rate readings. A table was then provided showing heart-rate readings taken at corresponding times over two minutes.

For Part (a), candidates were required to write an aim. Some candidates wrote aims that did not include appropriate verbs such as *to investigate* or *to determine*.

Candidate's Response to Part (a) – Sample 1

(a) Suggest a suitable aim for Jack's experiment.

Exercise increases heart rate from resting heart rate.

Examiner's Comments

This candidate did not write a suitable aim for the experiment. A suitable aim would have been *to investigate the effect of exercise on heart rate*.

Candidate's Response to Part (a) – Sample 2

(a) Suggest a suitable aim for Jack's experiment.

To investigate the heart rate of an individual at intervals after jumping jacks for 2 minutes.

Examiner's Comments

This candidate wrote a suitable aim for the experiment.

Candidate's Response to Part (a) – Sample 3

(a) Suggest a suitable aim for Jack's experiment.

To investigate the effect of exercise on the heart's rate. ✓

Examiner's Comments
This is an example of a suitable aim submitted by a candidate.

Candidate's Response to Part (a) – Sample 4

(a) Suggest a suitable aim for Jack's experiment.

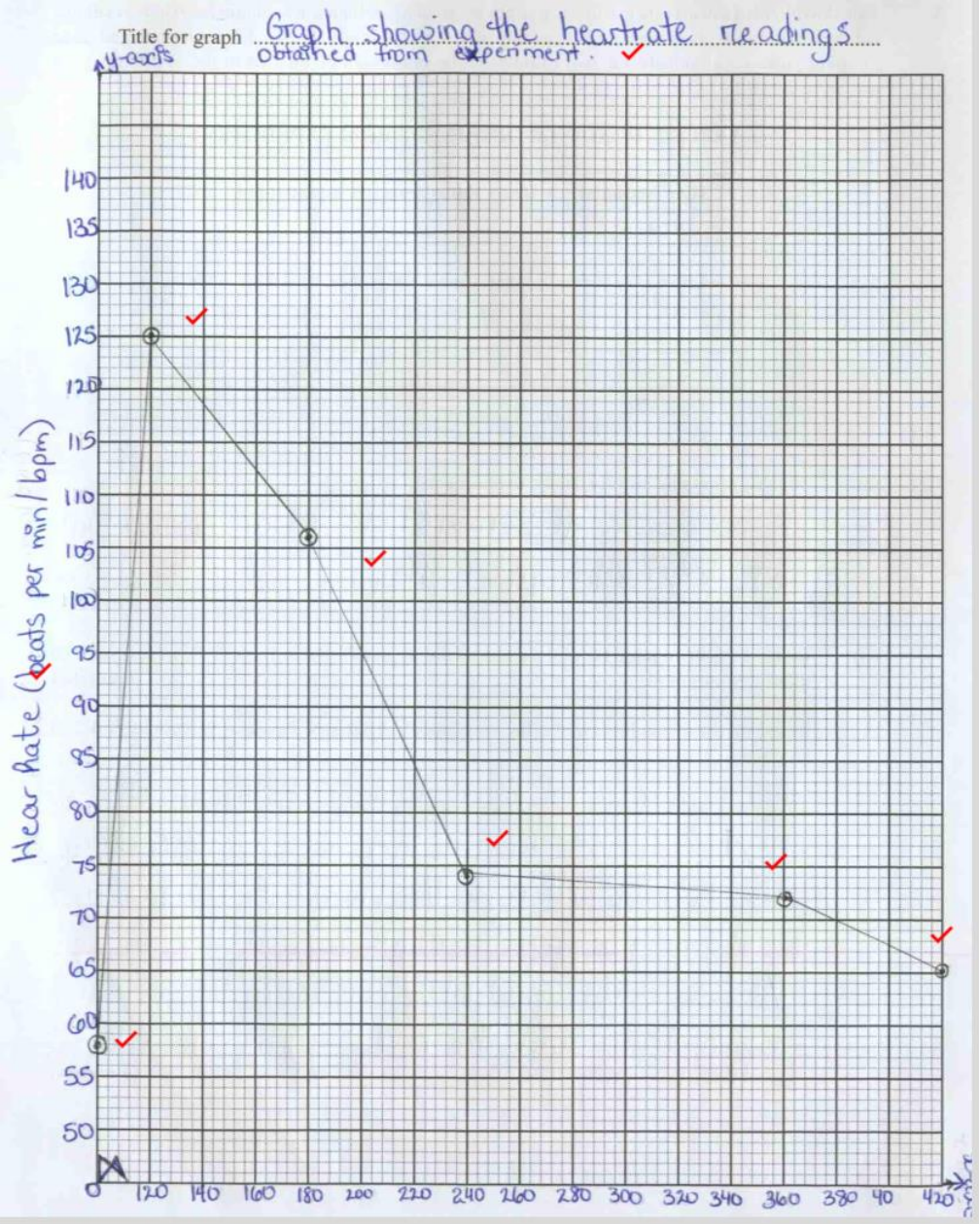
To determined the effect ~~exercise~~ jumping jacks ~~jacks~~ have on heart ✓ rate.

Examiner's Comments
This candidate wrote a suitable aim for the experiment.

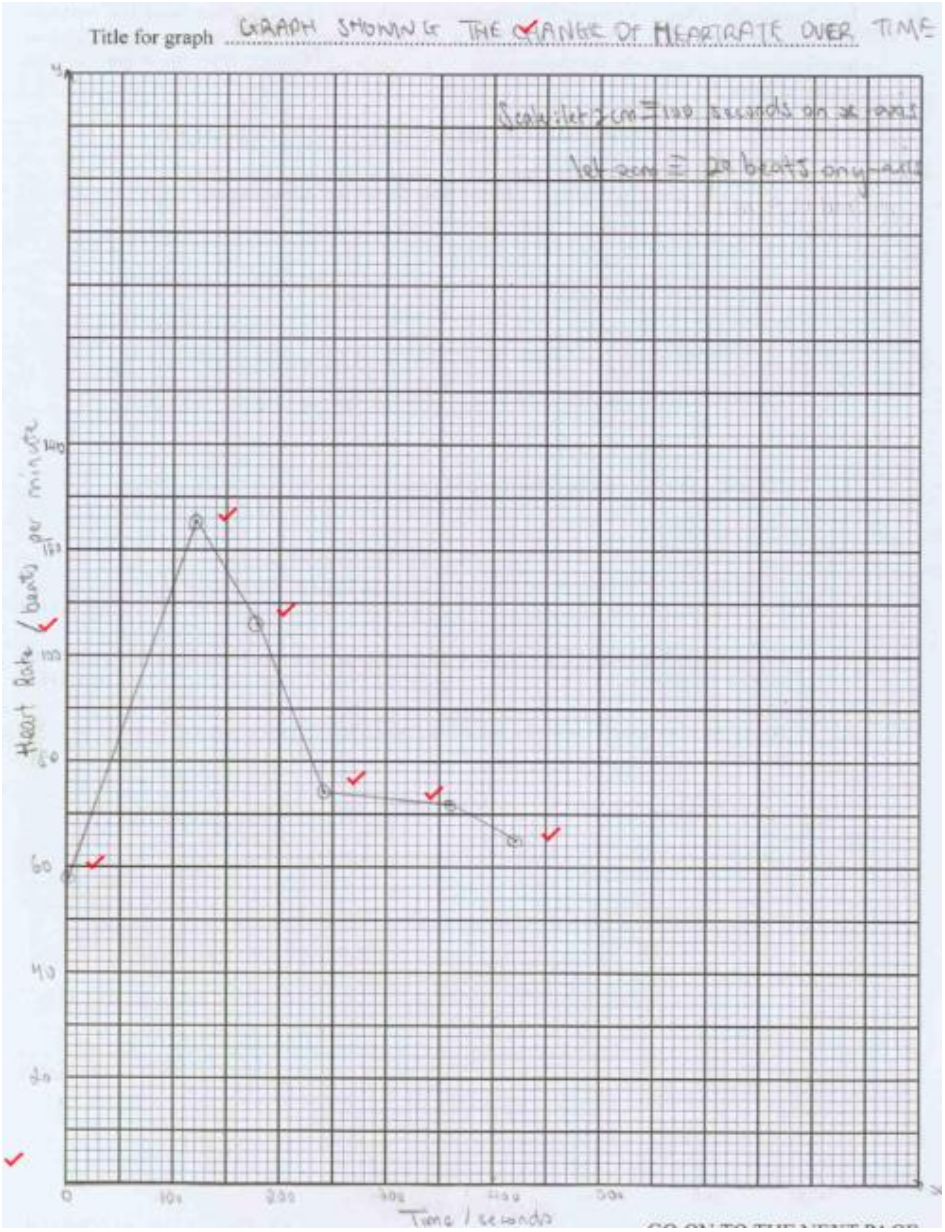
Part (b) required candidates to plot a graph using the results and then provide a title for the graph. Many candidates were able to score well on this part. Some candidates lost marks because they

- did not label the axes or did not provide a title for the graph
- drew bar graphs using discrete data
- used an inaccurate scale, that is, they used the data points instead of doing a uniform scale
- did not plot the points accurately.

Candidate's Response to Part (b) – Sample 1



Candidate's Response to Part (b) – Sample 2

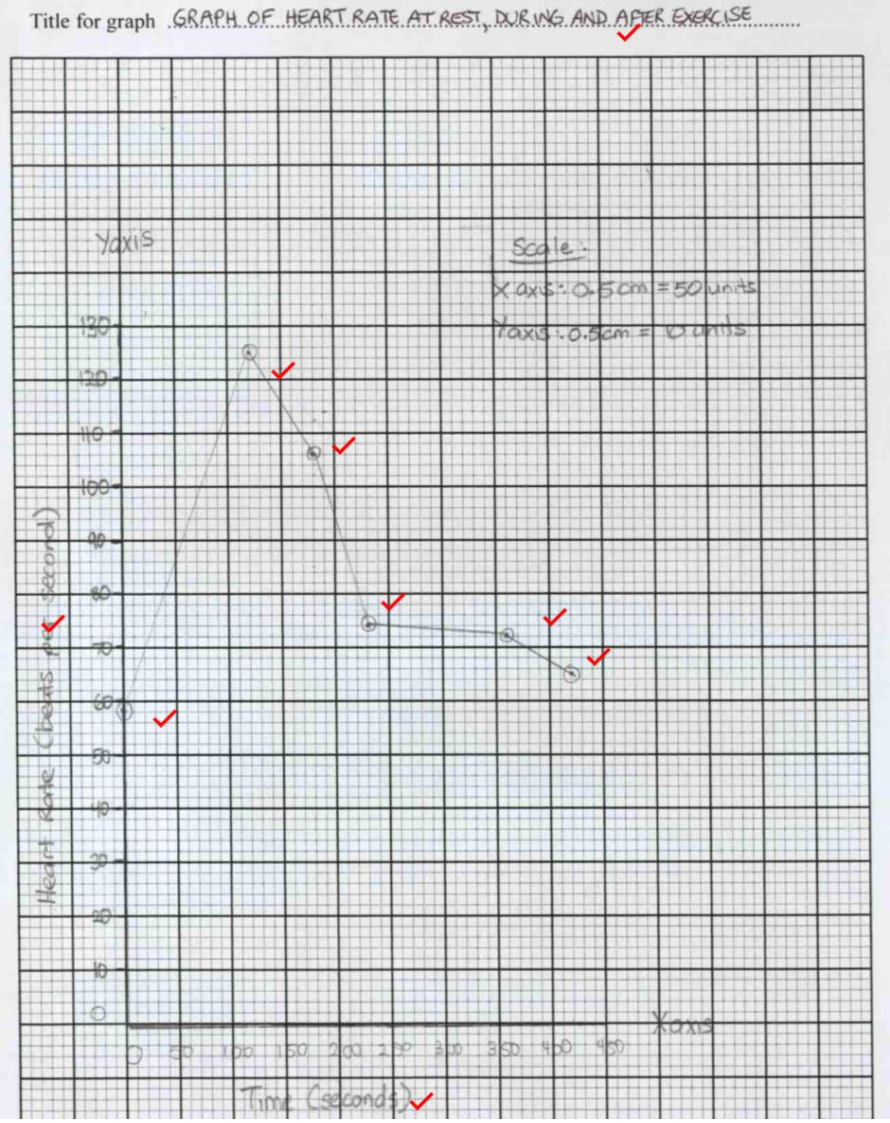


Examiner's Comments

The candidates in Sample 1 and Sample 2 obtained all six marks as shown below.

- Axes: Both axes labelled as per the table – 2 marks
- Scale: Accurate and more than half of the page – 1 mark
- Title: Acceptable – 1 mark
- Plot: Correctly done – 2 marks

Candidate's Response to Part (b) – Sample 3



Examiner's Comments

This candidate was able to obtain all six marks as shown below.

- Axes: Both axes labelled as per the table – 2 marks
- Scale: Accurate and more than half of the page – 1 mark
- Title: Acceptable – 1 mark (The mark was awarded as a benefit of the doubt; however, a better title would have been *Graph of Heart Rate at Rest and After Exercise*.)
- Plot – Correctly done – 2 marks

Part (c) required candidates to describe how the heart rate changed in the time interval stated. Candidates obtained the allocated marks for stating not only the trend, that is, the increase followed by a decrease in heart rate, but for also accurately stating the time periods. The following response is an example of one that would have been awarded full marks.

> There is an increase in heart rate between 0 and 120 seconds followed by a decrease in the heart rate between 120 and 240 seconds.

Candidate's Response to Part (c) – Sample 1

(c) Based on your graph, describe the roommate's heart rate between 0 seconds and 240 seconds.

The heartrate of the roommate between 0 seconds to 120 seconds rapidly increased by 67 bpm due to respiration so the heart beats faster to allow oxygen to move around the body. after 120 seconds The heartrate gradually drops due to enough oxygen flow and the body getting accustom to the jumping jacks. **(4 marks)**

Examiner's Comments

The candidate was able to obtain all four marks for noting the following.

- An increase in the heart rate, the time period when the increase occurred, and the heart rate
- A decrease in heart rate and the time period when the heart rate decreased

The following samples are given to highlight various ways in which correct answers were expressed.

Candidate's Response to Part (c) – Sample 2

(c) Based on your graph, describe the roommate's heart rate between 0 seconds and 240 seconds.

The roommate's heart rate increased drastically from 58 to ~~58~~ 125 bpm within 120 seconds. ~~between 0 and 240 seconds. Within those seconds as well it~~ It then gradually decreased from 125 bpm to 106 bpm and then 74 bpm within the other 120 seconds as the heart began to go back to its resting state.

(4 marks)

Candidate's Response to Part (c) – Sample 3

Based on your graph, describe the roommate's heart rate between 0 seconds and 240 seconds.

~~The roomate~~ roommate's heart rate at 0 seconds started low at 58 bpm while he was at rest and rapidly increased to a maximum of 185 bpm ~~of~~ after doing jumping jacks. The heart is now beating faster to supply more oxygen to his muscles as he uses more energy to exercise. After exercise from 120 seconds to 240 seconds his heart rate ~~decreased~~ decreases as the oxygen debt is being repaid and less energy is used.

(4 marks)

Candidate's Response to Part (c) – Sample 4

Based on your graph, describe the roommate's heart rate between 0 seconds and 240 seconds.

The roommate's heart rate increased at an increasing rate from 58 bpm until ~~this~~ peaking at 125 bpm at ~~this~~ 120 ~~seco~~ seconds. It then fell until 74 bpm over the course of the next 120 seconds.

Candidate's Response to Part (c) – Sample 5

Based on your graph, describe the roommate's heart rate between 0 seconds and 240 seconds.

The roommate's heart rate increased sharply from rest when the exercise commenced, peaking at 120 seconds. It then dropped quickly after the exercise stopped, returning closer to baseline at 240 seconds.

Examiner's Comments

The four candidates above each obtained the full four marks.

Part (d) required candidates to account for the shape of the graph between 0 seconds and 120 seconds. Many candidates did not score any marks on this part. Most answers were based on the shape of the graph, for example, 'it was triangular'. Very few candidates were able to relate the shape of the graph to the biological process of low oxygen concentration/high carbon dioxide concentration in the blood leading to increased heart rate.

An example of a good response is as follows.

> During exercise muscles contract more often and require more energy. The heart meets the demand by increasing the heart rate.
> - Or-
> During exercise there is an increase in circulation which gets oxygenated blood to your muscles faster. The heart meets the demand by increasing the heart rate.

Candidate's Response to Part (d) – Sample 1

(d) Account for the shape of the graph between 0 seconds and 120 seconds.

It's a straight line from 0seconds and 120 seconds due to the rapid ~~of~~ increase of the heart rate at rest. The heartrate jumped quickly because the heart is trying to supply oxygen ✓ and energy to continue jumping jacks ✓

(2 marks)

Examiner's Comments

The candidate received the marks for noting that the heart rate increased (jumped quickly) because the heart was trying to supply energy and oxygen.

Candidate's Response to Part (d) – Sample 2

(d) Account for the shape of the graph between 0 seconds and 120 seconds.

As the time increased so did the beats per minute, they were directly related. ✗

Examiner's Comments

This candidate did not receive any marks for this part of the question because there was no account given for the shape.

Candidate's Response to Part (d) – Sample 3

Account for the shape of the graph between 0 seconds and 120 seconds.

The sharp increase was due to the exercise. When the exercise commenced, more energy was required by the body compared to rest, therefore, the rate of respiration increased and more blood was needed throughout the body's muscles, accounting for the sharp increase in heart rate.

Examiner's Comments

A more succinct response could have been given but this candidate was given the benefit of the doubt in terms of how the answer was expressed. The candidate received two marks for noting that

- the sharp increase (in heart rate) was due to more energy being required
- more blood was needed.

For Part (e), many candidates were able to give two precautions which should have been taken while doing the experiment. Some candidates, however, gave suggestions which would have changed the experiment, and this was not accepted. It was expected that the precaution given would be suitable for the actual procedure that was used.

Candidate's Response to Part (e) – Sample 1

(e) Suggest TWO precautions that Jack should have taken during the experiment.

~~He should Water breaks sh~~

- The experiment was taken on a flat surface to exempt injuries from happening.
- Water present due to dehydration.

(2 marks)

Examiner's Comments

This candidate provided two acceptable precautions and gained the two marks.

Candidate's Response to Part (e) – Sample 2

(e) Suggest TWO precautions that Jack should have taken during the experiment.

Ensuring that he didn't push his roommate beyond his limit. ×

Giving his roommate adequate time to rest before beginning the experiment.

(2 marks)

Examiner's Comments

Only one acceptable precaution was provided and one mark was awarded.

Candidate's Response to Part (e) – Sample 3

(e) Suggest TWO precautions that Jack should have taken during the experiment.

Two precautions are: 1. Jack must ensure when he takes the heartrate of the ~~roomate~~ roommate at rest that the roommate is feeling calm otherwise that may ~~and not anxious~~ influence the heart rate taken. 2. Jack must ensure the roommate is not under the influence of any drugs that may influence the roommate's heartrate. ✓

(2 marks)

Examiner's Comments

This candidate was awarded two marks. The scenario indicated that the heart rates were taken at rest. However, it is appreciated that anxiety could affect the heart rate, so the candidate was awarded a mark for mentioning the importance of Jack ensuring that his roommate was calm. Medications or drugs could also affect the heart rate and so, this was also accepted.

Candidate's Response to Part (e) – Sample 4

(e) Suggest TWO precautions that Jack should have taken during the experiment.

Take the measurements in the same position. ✓

Clear the room to remove other variability. ✗

Examiner's Comments

This candidate was only able to provide one acceptable precaution and therefore received one mark.

Candidate's Response to Part (e) – Sample 5

(e) Suggest TWO precautions that Jack should have taken during the experiment.

Two precautions he should take are: ensure the app on the phone is calibrated properly ✓, if possible and ensure that little to no physical exercise was conducted immediately before the experiment to give an accurate resting heart rate.

Examiner's Comments

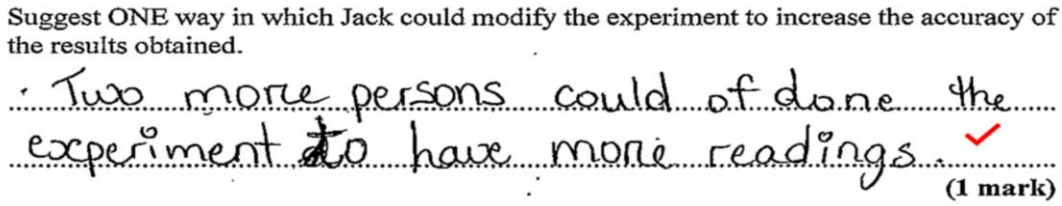
This candidate gave two acceptable precautions and was awarded the full two marks.

Some examples of other acceptable precautions are provided below.

- Keep the rate of the jumping jacks consistent.
- Use the same position when taking the readings.
- Ensure that his roommate is not on any medications (or chemicals, for example, alcohol) that can alter the heart rate.
- Ensure that the roommate is healthy enough/fit enough to do two minutes of continuous jumping jacks.
- Use a stopwatch.

Part (f) was linked to Part (e) in that candidates were asked for one way in which the experiment could have been modified to increase its accuracy. A common response which was acceptable was *to repeat the experiment and obtain two sets of values so that an average could be taken*.

Candidate's Response to Part (f) – Sample 1


Suggest ONE way in which Jack could modify the experiment to increase the accuracy of the results obtained.

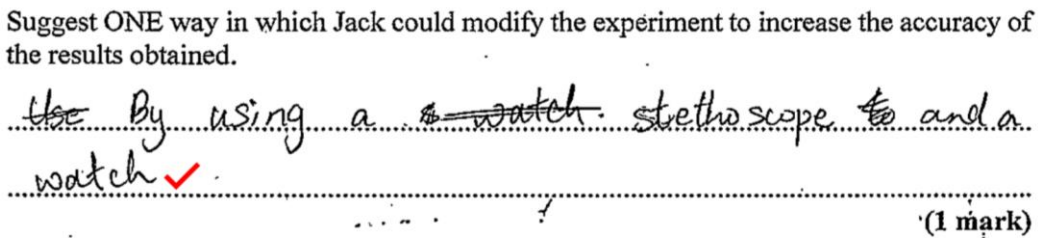
Two more persons could of done the experiment to have more readings. ✓

(1 mark)

Examiner's Comments

This modification was accepted because one of the answers on the mark scheme was to repeat the experiment.

Candidate's Response to Part (f) – Sample 2


Suggest ONE way in which Jack could modify the experiment to increase the accuracy of the results obtained.

~~Use~~ By using a ~~watch~~ stethoscope ~~to~~ and a watch ✓

(1 mark)

Examiner's Comments

This modification was accepted because one of the answers on the mark scheme was the use of a more accurate device for monitoring heart rate.

Candidate's Response to Part (f) – Sample 3

Suggest ONE way in which Jack could modify the experiment to increase the accuracy of the results obtained.

Jack can take the reading of his roommate's heart rate at shorter intervals to increase the accuracy of results obtained. ✓ **(1 mark)**

Examiner's Comments

The modification suggested by this candidate was acceptable and he mark was awarded. The candidate could also have stated that in addition to taking the readings at shorter intervals, all time intervals should be constant.

Candidate's Response to Part (f) – Sample 4

Suggest ONE way in which Jack could modify the experiment to increase the accuracy of the results obtained.

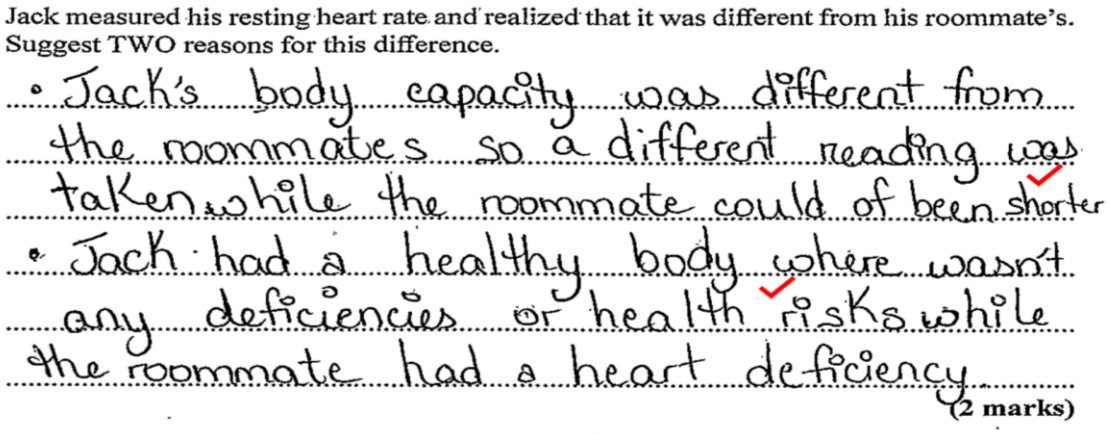
He can repeat the procedure with more individuals and ✓ or mean then take the average readings at the various intervals. **(1 mark)**

Examiner's Comments

This candidate's modification was acceptable.

For Part (g), candidates were required to suggest two reasons why the resting heart rate differed in two individuals. Overall, this part was well done. The most common reasons were *differences in age*, *gender*, *fitness level or health status of the individuals*.

Candidate's Response to Part (g) – Sample 1


Jack measured his resting heart rate and realized that it was different from his roommate's.
Suggest TWO reasons for this difference.

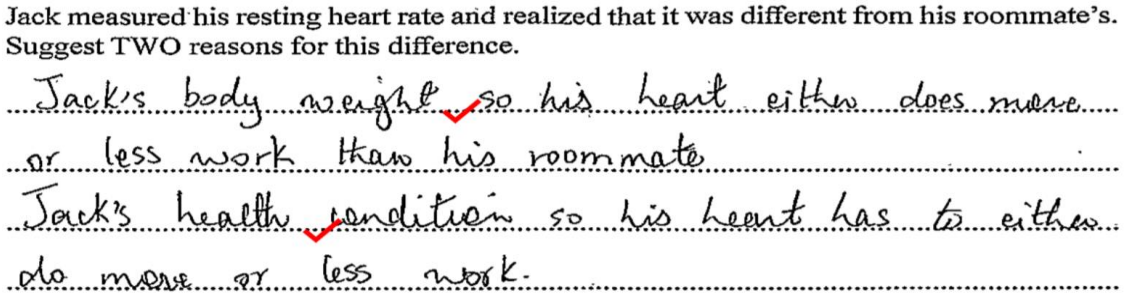
- Jack's body capacity was different from the roommates so a different reading was taken, while the roommate could of been shorter
- Jack had a healthy body where wasn't any deficiencies or health risks while the roommate had a heart deficiency.

(2 marks)

Examiner's Comments

Both differences given by this candidate (height and health status) were accepted.

Candidate's Response to Part (g) – Sample 2


Jack measured his resting heart rate and realized that it was different from his roommate's.
Suggest TWO reasons for this difference.

Jack's body weight so his heart either does more or less work than his roommate

Jack's health condition so his heart has to either do more or less work.

Examiner's Comments

Both differences given by this candidate (weight and health status) were accepted.

Candidate's Response to Part (g) – Sample 3

Jack measured his resting heart rate and realized that it was different from his roommate's. Suggest TWO reasons for this difference.

1. Any difference in emotion such as happiness, excitement or anxiety may cause a change in a person's heartrate.
2. ~~The size difference in weight may also~~ Any ~~underlying~~ diseases such as hypertension, obesity or diabetes may also affect a person's heart rate.

Examiner's Comments

Both differences given by this candidate (emotional state and diseases) were accepted.

Candidate's Response to Part (g) – Sample 4

Jack measured his resting heart rate and realized that it was different from his roommate's. Suggest TWO reasons for this difference.

Jack exercises less ~~th~~ and therefore has a lower resting heart rate.

His He has a heart disease which slow down his heart rate.

Examiner's Comments

Both differences given by this candidate (fitness level and health status) were accepted.

Candidate's Response to Part (g) – Sample 5

Jack measured his resting heart rate and realized that it was different from his roommate's. Suggest TWO reasons for this difference.

Two reasons are: Jack may be different in ~~size~~ mass (weight and height) and Jack may have a different degree or level of aerobic fitness / conditioning.

Examiner's Comments

Both differences given by this candidate (weight/height and fitness level) were accepted.

GENERAL RECOMMENDATIONS

Teachers/instructors and potential candidates should pay attention to the following recommendations.

- The frequent use of 'practice questions' from past exam papers or from textbooks: This stimulus material can be used in many ways to elicit responses which can then be evaluated for relevance, accuracy, clarity and completeness. Faulty terminology may also be addressed at this time, followed by appropriate remedial sessions.
- Unfortunately, too many candidates continue to provide poor responses to the parts of the question requiring use of knowledge. It could be that they learned the information but did not learn the technique of applying that information to explain a phenomenon or to respond to an observation. In many instances, candidates omitted questions that require use of knowledge. The skill of applying information using higher order thinking must be reinforced. One way to achieve this is through adequate exposure to Use of Knowledge (UK) questions during instruction and as part of the exam preparation.
- In the words of one of our seed-makers, "novel approaches need to be adopted by educators in an effort to correct the misconceptions".