

## Paper 1

|    |              |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | <b>B</b>     | Hepatic refers to the <i>liver</i> . Mesophyll refers to the <i>leaf</i> .                                                                                                                                                                                                                                                                                                                                                   |
| 2  | <b>B</b>     | Proteins cannot be sent for modification. Proteins (enzymes present in lysosome), membrane proteins present in cell membrane may be affected.                                                                                                                                                                                                                                                                                |
| 3  | <b>D</b>     | Prokaryotes do not have intermembranous systems. Chloroplast is a double membrane bound organelle.                                                                                                                                                                                                                                                                                                                           |
| 4  | <b>B</b>     | Each nucleotide contains a sugar, a base and a phosphate group. Thus, a gene that contains 900 phosphate groups also contains 900 bases.                                                                                                                                                                                                                                                                                     |
| 5  | <b>C</b>     | Amino acids do not bind to mRNA.<br>A particular <i>number and types</i> of amino acids are chemically joined together by peptide bonds via condensation reaction, in a particular <i>sequence</i> next to each other to form polypeptide. Polypeptide will then fold to form protein. Protein is a structure with specific 3-dimensional conformation, hence able to have a specific function.                              |
| 6  | <b>C</b>     | There should not be uracil base present in DNA.<br>There should not be thymine present in RNA.<br>Follow the complementary base pairing rule: A-T (in DNA-DNA) or A-U (in DNA-RNA), and G-C (in DNA-DNA or DNA-RNA).                                                                                                                                                                                                         |
| 7  | <b>C</b>     | 1. Mutations are spontaneous and random. They give rise to new alleles. 2. Not true. 4. May not be true.                                                                                                                                                                                                                                                                                                                     |
| 8  | <b>D</b>     | Man with blood type AB is not able to pass down a $I^O$ allele. Blood type O is not possible.                                                                                                                                                                                                                                                                                                                                |
| 9  | <b>C</b>     | The mother's genotype is $X^H X^h$ as the couple has a son who is haemophiliac. This son has inherited the $X^h$ from her since the father will pass down the Y chromosome.                                                                                                                                                                                                                                                  |
| 10 | <b>B</b>     | Fertilisation leads to doubling of DNA content. DNA replication in interphase again doubles the amount of DNA.                                                                                                                                                                                                                                                                                                               |
| 11 | <b>B</b>     | Alignment of the chromosomes at the equator of the cell ensures that the sister chromatids separate to the opposite poles. The formation of the nuclear membrane around the daughter chromosomes ensure that each cell will receive a specific chromosome.                                                                                                                                                                   |
| 12 | <b>A / B</b> | Events in cytokinesis.                                                                                                                                                                                                                                                                                                                                                                                                       |
| 13 | <b>A</b>     | Glucose can be synthesized into cellulose required for cell wall structure in plants only.<br>In animals only, excess glucose is synthesized into glycogen for storage only in liver and muscles. Plants store excess glucose in the form of starch granules/grains within chloroplasts.<br>In animals only, glycogen can be broken down back into glucose for use in cellular processes like respiration to release energy. |
| 14 | <b>C</b>     | Lactose is a disaccharide made of glucose and galactose molecules. The chemical formula for both glucose and galactose is $C_6H_{12}O_6$ . During condensation reaction, one water molecule i.e. $H_2O$ is removed when both molecules are joined together via glycosidic bond.<br>Hence, $[C_6H_{12}O_6 \text{ (times) } 2] \text{ (minus) } H_2O \text{ (equals) } C_{12}H_{22}O_{11}$                                     |
| 15 | <b>C</b>     | The temperature differences are $67^\circ\text{C}$ (food 1), $86^\circ\text{C}$ (food 2), $11^\circ\text{C}$ (food 3) and $66^\circ\text{C}$ (food 4).<br><br>Higher lipid content result in higher energy during burning. Lipid molecules are good energy storage molecules.                                                                                                                                                |

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| 16 | <b>D</b> | <p>Phospholipid is a type of lipid molecule made up of 1 glycerol molecule chemically combined (via ester linkages by condensation reactions) with 2 fatty acid chains and 1 inorganic phosphate group.</p> <p>Phospholipid molecule could be modified with replacement of the inorganic phosphate group with a short carbohydrate chain (or called: sugar residues) that is chemically combined to the glycerol molecule.</p>                                                                                                                                                                                                                                                                                               |
| 17 | <b>C</b> | <p>Boiling will destroy cell membranes' structure. Hence, osmosis that requires selectively permeable membrane will not be able to occur. Free water molecules will be bounded to solutes (i.e. salt), hence preventing osmosis since there will not be any difference in water potentials.</p> <p>Solutes will still be able to move by simple diffusion (with no requirement of membrane presence), from higher concentration of salts in the solution towards lower concentration of salts in the cell sap of potato.</p>                                                                                                                                                                                                 |
| 18 | <b>D</b> | <p>Cell surface membrane is considered hydrophobic due to the presence of fatty acid chains. Fat soluble molecules can move across directly via simple diffusion. For water soluble molecules, transmembrane protein will be required for a through passage of these molecules.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 19 | <b>A</b> | <p>Lock refers to the enzyme with the active site of specific 3-dimensional conformation. Key refers to the substrate (with specific conformation, size and charge) complementary to the active site of the enzyme involved. Usually enzymes have name ending with '-ase', but with some ending with '-in'.</p>                                                                                                                                                                                                                                                                                                                                                                                                              |
| 20 | <b>B</b> | <p>At temperature below optimum, enzymes are inactive due to low kinetic energy. Higher temperature i.e. higher heat energy will result in higher kinetic energy of molecules. Enzyme at 60°C will have higher kinetic energy as compared to those at 40°C.</p> <p>At temperature above optimum, enzymes are denatured i.e. loss of active site with specific 3-dimensional conformation. This is due to the excess heat energy disrupting weak chemical bonds within the protein structure of enzymes. Hence, enzyme-substrate complex will not be formed.</p> <p>During enzyme-substrate complex formation, temporary chemical bonds e.g. hydrogen bonds are formed between enzyme (at the active site) and substrate.</p> |
| 21 | <b>A</b> | <p>Comparing 1 and 2, the results prove that zinc ions help to increase rate by 10 times. And water as a substituent, decreased the rate by 10 times.</p> <p>Comparing 1 and 3, the results prove that retinoic acid helps to increase rate by 25 times. Hence, acidic pH denaturation to the enzyme will not be possible.</p>                                                                                                                                                                                                                                                                                                                                                                                               |
| 22 | <b>C</b> | <p>Fact. Ileum as part of small intestine.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 23 | <b>B</b> | <p>The constriction of oesophagus lumen at region N leads to deduction that food bolus is moving to the left. This is a result of contraction of circular muscles, and the relaxation of longitudinal muscles at region N.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 24 | <b>D</b> | <p>Organ 1 – mouth contains salivary amylase which catalyses the hydrolysis of glycosidic bonds within starch molecules to form maltose.</p> <p>Organ 2 – stomach churns the food to break up food into smaller pieces with higher surface area to volume ratio.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|    |          |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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|    |          | Organ 3 – mouth performs chewing of food to break up food into smaller pieces with higher surface area to volume ratio.<br>Organ 4 – stomach contains pepsin which catalyses the hydrolysis of bonds within proteins to form polypeptides.                                                                                                                                                                                                 |
| 25 | <b>A</b> | Stomach (A) is involved in protein digestion and food is temporarily held in the stomach for 3-4 h before release into the duodenum.<br>Pancreas (B) release pancreatic juice containing various digestive enzymes into the duodenum but is not involved in egestion.<br>Duodenum (C) is involved in carbohydrate digestion but not assimilation.<br>Gall bladder is stores bile for fat emulsification but is not involved in absorption. |
| 26 | <b>B</b> | At lower carbon dioxide concentration, the increase in carbon dioxide concentration increases rate of photosynthesis. But at higher carbon dioxide concentration, the experiment at higher temperature results in a higher rate of photosynthesis.                                                                                                                                                                                         |
| 27 | <b>A</b> | 1 has no chlorophyll and 2 has.                                                                                                                                                                                                                                                                                                                                                                                                            |
| 28 | <b>A</b> | Fact.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 29 | <b>A</b> | A is the phloem which is involved in translocation.                                                                                                                                                                                                                                                                                                                                                                                        |
| 30 | <b>D</b> | Region 1 on the leaf is where the xylem is found. D is the xylem                                                                                                                                                                                                                                                                                                                                                                           |

## Paper 2

Mark scheme abbreviations (*aligned with Cambridge*)

*/* alternative answers for the same point

**()** contents of brackets are not required but should be implied

**+** statements on both sides of the **+** are needed for that mark

**R** reject

**A** accept (for answers correctly cued by the question, or by extra guidance)

**AVP** alternative valid point (where a greater than usual variety of responses is expected)

**AW** alternative wording (where responses vary more than usual)

**ECF** error carried forward

**lg** ignore (for incorrect but irrelevant responses)

**Max** indicates the maximum number of marks that can be given

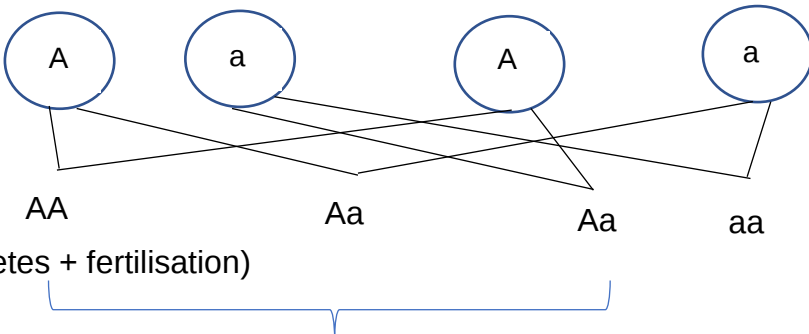
**ORA** or reverse argument

**underline** actual word given must be used by candidate (grammatical variants accepted)

| Q 1 |  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Guidance                                                                                                                                                         |
|-----|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (a) |  | <p>(Correct measurement with units)</p> <p>Length of XY in Figure = 3.7 cm</p> <p>Magnification<br/>= Length of XY in Figure/ Actual length of XY</p> <p><b>a</b> Actual length of XY<br/>= 3.7 cm/ 47 500<br/>= 0.00007789 cm</p> <p><b>b</b> = 0.78 <math>\mu\text{m}</math><br/>answer with unit</p>                                                                                                                                                                                                                          | <p><b>1 A</b> 3.8 cm</p> <p><b>R</b> measurement recorded to 1 dp in mm or 2 dp in cm</p> <p><b>R</b> 3.6 cm</p> <p><b>1 A</b> 0.80 <math>\mu\text{m}</math></p> |
| (b) |  | <p>Mitochondria <u>oxidises food substances to release energy/ Mitochondria is the site of aerobic respiration, it releases energy</u></p> <p>energy is used for the <u>synthesis of proteins at Z/ formation of peptide bonds between amino acids to form polypeptides at Z</u></p> <p>Enzymes are made of proteins</p> <p>Z is the smooth endoplasmic reticulum – site of detoxification</p> <p>Z is the Golgi apparatus – chemically modifies proteins send to it from the rER so that functional enzymes can be produced</p> | <p><b>1</b></p> <p><b>1</b></p> <p><b>1</b></p> <p><b>1</b></p> <p><b>R: sER synthesises fats and steroid hormones as it does</b></p>                            |

|                                                                                              |  |  |                                  |
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|                                                                                              |  |  | not fit context of the question. |
| <b>Feedback / Explanation:</b><br><b>Mitochondria release energy and not produce energy.</b> |  |  | <b>[Total: 5]</b>                |

| Q 2                                                                 |   | Answer                                                                                                                                      | Guidance                                              |
|---------------------------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| (a)                                                                 | a | A specific <u>sequence of nucleotides</u> , as <u>part of DNA molecule</u> , which codes for synthesis of one specific <u>polypeptide</u> . | <b>1</b> A protein / RNA / <u>unit of inheritance</u> |
| (b)                                                                 |   | 20 %                                                                                                                                        | <b>1</b>                                              |
| (c)                                                                 | a | The remaining 15 % of DNA contains a lot more unshared / uncommon gene.                                                                     | <b>1</b>                                              |
|                                                                     | b | Different <u>mRNAs</u> are produced from <u>transcription</u> .                                                                             | <b>1</b> R mutation                                   |
|                                                                     | c | Different <u>polypeptides / proteins</u> are produced from <u>translation</u> .                                                             | <b>1</b> R prions                                     |
|                                                                     | d | Different genes determine different physical traits/ characteristics.                                                                       | <b>1 (Max 2)</b>                                      |
| (d)                                                                 | a | probability of introducing novel allergens / carcinogens                                                                                    | <b>1</b>                                              |
|                                                                     | b | monopolistic behaviour of biotechnology companies                                                                                           | <b>1</b>                                              |
|                                                                     | c | lack of mandatory food labelling in some countries e.g., GM food containing a gene derived from swine                                       | <b>1</b>                                              |
|                                                                     | d | <b>AVP</b>                                                                                                                                  | <b>1</b><br><b>Max 1</b>                              |
| <b>Feedback / Explanation:</b><br>Question was generally well-done. |   |                                                                                                                                             | <b>[Total: 5]</b>                                     |

| Q 3 | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Guidance                                                                                                                                                                                                  |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (a) | <p><b>a</b> Short lifecycle/ lifespan thus results of experiment can be observed quickly</p> <p><b>b</b> small, easy to handle/ small, easy to keep</p> <p><b>c</b> cheap to keep – food required is affordable/ easily available</p> <p><b>d</b> large sample size can be obtained as female lays large number of eggs at one go</p>                                                                                                                                                                                                                                                                                 | <p><b>1</b></p> <p><b>1</b></p> <p><b>1</b></p> <p><b>1 (Max 1)</b></p>                                                                                                                                   |
| (b) | <p><b>a</b> alleles definition<br/>Let A represents the allele for normal wings + Let a represents the allele for vestigial wings</p> <p><b>b</b> state phenotype and genotype + a mating “X” present at either phenotypes or genotypes or at both<br/>Parental Phenotypes: normal wings x normal wings<br/>Parental Genotype: Aa Aa</p> <p><b>c</b></p>  <p>(segregation of gametes + fertilisation)</p> <p><b>d</b> offspring phenotypes: normal wings 3 : vestigial wings 1<br/>phenotype of offspring + ratio of 3:1 shown</p> | <p><b>1 R</b> different alphabets, superscripts e.g. I<sup>A</sup> or C<sup>w</sup></p> <p><b>1 R</b> phenotype is identified as carrier</p> <p><b>1 R</b> if gametes are not circled</p> <p><b>1</b></p> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                          |
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| <p><b>Feedback / Explanation:</b><br/> Question was generally well-done.</p> <p>When to use super script symbols:</p> <p>(1) When incomplete dominance occurs, an allele does <u>not</u> show complete dominance or recessiveness over another allele. So rather than using upper- and lowercase letters, use a letter e.g. C with a superscript to indicate an allele of the gene.</p> <p>(1) When codominance occurs, neither allele is dominant or recessive, so rather than using upper- and lowercase letters, use a letter e.g. C with a superscript to indicate an allele of the gene.</p> <p>(2) Multiple alleles.</p> <p>Offspring should only be classified as F<sub>1</sub> only if the parents are pure breeds i.e. homozygotes.</p> | <p><b>[Total: 5]</b></p> |
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| Q 4                                                                                                                                                                      | Answer                                       |                                                                                                                                                                                                                                                                                                                        | Guidance                  |              |   |                                                             |   |                                                                 |   |                                              |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------|---|-------------------------------------------------------------|---|-----------------------------------------------------------------|---|----------------------------------------------|---|
| (a)                                                                                                                                                                      |                                              | <table><tr><td>curves</td><td>descriptions</td></tr><tr><td>B</td><td>change in distance between centromeres of sister chromatids</td></tr><tr><td>A</td><td>change in distance between centromeres and poles of the spindle</td></tr><tr><td>C</td><td>change in distance between the poles of cell</td></tr></table> | curves                    | descriptions | B | change in distance between centromeres of sister chromatids | A | change in distance between centromeres and poles of the spindle | C | change in distance between the poles of cell | 1 |
|                                                                                                                                                                          | curves                                       | descriptions                                                                                                                                                                                                                                                                                                           |                           |              |   |                                                             |   |                                                                 |   |                                              |   |
|                                                                                                                                                                          | B                                            | change in distance between centromeres of sister chromatids                                                                                                                                                                                                                                                            |                           |              |   |                                                             |   |                                                                 |   |                                              |   |
|                                                                                                                                                                          | A                                            | change in distance between centromeres and poles of the spindle                                                                                                                                                                                                                                                        |                           |              |   |                                                             |   |                                                                 |   |                                              |   |
| C                                                                                                                                                                        | change in distance between the poles of cell |                                                                                                                                                                                                                                                                                                                        |                           |              |   |                                                             |   |                                                                 |   |                                              |   |
| (b)                                                                                                                                                                      | a                                            | centromeres divide/separate                                                                                                                                                                                                                                                                                            | 1 R split                 |              |   |                                                             |   |                                                                 |   |                                              |   |
|                                                                                                                                                                          | b                                            | <u>sister chromatids are pulled apart / separate</u>                                                                                                                                                                                                                                                                   | 1 R split                 |              |   |                                                             |   |                                                                 |   |                                              |   |
|                                                                                                                                                                          | c                                            | centromeres lead first to the <u>opposite poles</u> of the cell                                                                                                                                                                                                                                                        | 1 R ends of cell          |              |   |                                                             |   |                                                                 |   |                                              |   |
|                                                                                                                                                                          | d                                            | <u>quote data</u> from 15 <sup>th</sup> to the 30 <sup>th</sup> minute, the distance between centromeres of sister chromatids increases from 0 to 50 μm                                                                                                                                                                | 1 (Max 2)                 |              |   |                                                             |   |                                                                 |   |                                              |   |
| (c)                                                                                                                                                                      |                                              | chromatids <u>decondense / uncoiled</u> to form chromatin (R: chromosome).                                                                                                                                                                                                                                             | 1 R condense, re-condense |              |   |                                                             |   |                                                                 |   |                                              |   |
| <b>Feedback / Explanation:</b><br>Question was generally well-done.<br><br>Some candidates were careless with the use of words. Weaker answers contradicted their ideas. |                                              |                                                                                                                                                                                                                                                                                                                        | [Total: 4]                |              |   |                                                             |   |                                                                 |   |                                              |   |

| Q 5                                                                                                                                                                                                                                                                                                                                                                                                                     |          | Answer                                                                                                                                                                                  | Guidance                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| (a)                                                                                                                                                                                                                                                                                                                                                                                                                     |          | correct labelling + <u>integral / transmembrane / transport / channel / carrier protein/ transporter</u>                                                                                | <b>1 R</b> glycoprotein |
| (b)                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>a</b> | <i>fluid</i><br><u>Phospholipids</u> (and proteins) can <u>move freely / laterally</u> within the phospholipid bilayer.                                                                 | <b>1</b>                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>b</b> | <i>mosaic</i><br>Different <u>proteins</u> are <u>randomly embedded / scattered</u> among the phospholipids.                                                                            | <b>1</b>                |
| (c)                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>a</b> | <i>compare:</i><br>The water potential of concentrated salt solution is <u>more negative</u> than the <u>cell sap / cytoplasm</u> of potato cell.                                       | <b>1</b>                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>b</b> | <i>process:</i><br>Water <u>molecules</u> move (out) from cell sap / cytoplasm of potato cell into concentrated salt solution by <u>osmosis across selectively permeable membrane</u> . | <b>1</b>                |
|                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>c</b> | <i>result:</i><br>Cell becomes <u>plasmolysed with cell membrane pulled away from cellulose cell wall / vacuole shrunk in volume</u> .                                                  | <b>1</b>                |
| <b>Feedback / Explanation:</b><br>Question was generally well-done.<br><br>Comparison must be done with reference to <u>named fluid</u> in the plant cell i.e. cell sap / cytoplasm. Water <u>molecules</u> must be emphasized for its movement. Some students with poor English mentioned the water molecules <i>travelling</i> .<br>Complete phrase for osmosis involving selectively permeable membrane is required. |          |                                                                                                                                                                                         | <b>[Total: 5]</b>       |

| Q 6                                                                                                                                                                                                                                                                                                                                                                            |   | Answer                                                                                                                                                                                                        | Guidance            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| (a)                                                                                                                                                                                                                                                                                                                                                                            |   | $\pm 72 \%$                                                                                                                                                                                                   | <b>1</b>            |
| (b)                                                                                                                                                                                                                                                                                                                                                                            | a | At <u>optimum</u> pH 7, the <u>rate of enzyme-substrate complex formation</u> is at its maximum.                                                                                                              | <b>1</b>            |
|                                                                                                                                                                                                                                                                                                                                                                                | b | At pH above or below optimum 7, enzyme is <u>denatured</u> with the <u>specific 3-dimensional conformation</u> of the <u>active site is destroyed</u> to be <u>no longer complementary to the substrate</u> . | <b>1 R</b> inactive |
|                                                                                                                                                                                                                                                                                                                                                                                | c | Hence, the <u>rate of enzyme-substrate complex formation decreases</u> .                                                                                                                                      | <b>1</b>            |
|                                                                                                                                                                                                                                                                                                                                                                                | d | <u><b>quote extensive data</b></u>                                                                                                                                                                            | <b>1</b>            |
| <p><b>Feedback / Explanation:</b><br/> Question was generally well-done.</p> <p>Candidates who performed well gave <b>one value</b> representing the change. Weaker answers were vague or qualitative e.g., 'a bigger/higher change' or 'an increase'.</p> <p>Stronger answers always included the term enzyme-substrate complex and elaborated the ideas of denaturation.</p> |   |                                                                                                                                                                                                               | <b>[Total: 4]</b>   |

| Q 7 |   | Answer                                                                                                  | Guidance                |
|-----|---|---------------------------------------------------------------------------------------------------------|-------------------------|
| (a) | a | detoxification / named e.g., alcohol metabolism/break down                                              | 1                       |
|     | b | breakdown of haemoglobin / old red blood cells                                                          | 1                       |
|     | c | storage of iron / ions / vitamins                                                                       | 1                       |
|     | d | synthesis / storage of glycogen or fats (from excess glucose) / regulate blood glucose                  | 1                       |
|     | e | release of glucose / hydrolysis of glycogen                                                             | 1                       |
|     | f | synthesis of <u>plasma</u> proteins / amino acids / named e.g., fibrinogen, prothrombin                 | 1                       |
|     | g | secrete / produce / release bile                                                                        | 1                       |
|     | h | <u>deamination</u> of excess amino acids                                                                | 1                       |
|     | i | produces enzymes                                                                                        | Max 2                   |
| (b) | a | Bile will be not/lesser <u>released</u> from gall bladder (into duodenum of small intestine).           | 1 R produced / secreted |
|     | b | Large fat globules/droplets will <b>not</b> be <u>emulsified / broken up</u> into smaller fat droplets. | 1 R broken down         |
|     | c | <u>Lipase</u> will <u>hydrolyse / digest / break down</u> fats <u>slower</u> .                          | 1                       |
|     | d | Glycerol <b>and</b> fatty acids will be produced <u>slower</u> .                                        | 1<br>Max 3              |
| (c) |   | oesophagus / esophagus                                                                                  | 1                       |

|                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                                                                                                                                                                                  |                   |
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| (d)                                                                                                                                                                                                                                                                                                                                                                                                                   |  | Proteins will remain <u>longer</u> in the stomach to be <u>digested more/fully</u> (into polypeptides) / there is <u>longer</u> time for <u>digestion</u> of proteins in stomach | <b>1</b>          |
| <p><b>Feedback/ Explanation:</b></p> <p>(a) <b>DEAMINATION</b> must be spelt right. Also important to note it is of <u>EXCESS</u> amino acids</p> <p>(b) It is important to note that bile can still be produced by the liver, and stored in the gall bladder. What is disrupted is the <b>RELEASE</b> of bile into the duodenum.</p> <p>“<b>Secrete</b>” is a word that implies both produce <u>and</u> release.</p> |  |                                                                                                                                                                                  | <b>[Total: 7]</b> |

| Q 8 |                                                  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Guidance                                                                                                                                                   |
|-----|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (a) | a                                                | $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ Or<br>$6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$<br><b>Reject: word equation / equation not balanced</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>1</b><br><br>include conditions of chlorophyll and sunlight /light/ light energy                                                                        |
| (b) | A<br>A<br><br>B<br>B<br><br>C<br>C<br><br>D<br>D | air chambers in the <u>palisade</u> (mesophyll) tissue / more air spaces<br>enable the leaf to float / float to absorb more light for photosynthesis / carbon dioxide to diffuse quickly to mesophyll cells<br><br><u>large air chambers present</u><br>enable the leaf to float / float to absorb more light for photosynthesis / carbon dioxide to diffuse quickly to mesophyll cells<br><br>stomata on the upper surface / upper epidermis only<br>allows carbon dioxide to diffuse into the leaf from the air for photosynthesis<br><br>lower epidermal cells contain chloroplasts<br>Light can be absorbed for photosynthesis.<br><br><b>Reject: waxy cuticle / epithelium / intermolecular air space</b><br><b>Note: air chambers are air spaces. A normal leaf has these.</b> | <b>1</b><br><b>1</b><br><br><b>1</b><br><b>1</b><br><br><b>1</b><br><b>1</b><br><br><b>1</b><br><b>1</b><br><br>any 2 differences with correct explanation |
|     |                                                  | <b>Feedback / Explanation:</b><br>(a) Chemical equations should always be balanced.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>[Total: 5]</b>                                                                                                                                          |

| Q 9                                                                                                                                                                                                                                                                     |                                       | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Guidance                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| (a)                                                                                                                                                                                                                                                                     | S<br>P<br>L<br>A                      | size at least 75%<br>correct plots<br>best fit<br>axes are correctly labelled with units + no odd scale<br>refer to back for graph drawing                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1<br>1<br>1<br>1<br>No mark for title |
| (b)                                                                                                                                                                                                                                                                     | a<br><br>b<br><br>c<br><br>d<br><br>e | From 13:00 to 21:00, the concentration of carbon dioxide increases from 0.003 % to 0.03 %.<br><br>At 1300, the <u>light intensity is the highest</u> , <u>rate of photosynthesis is the highest</u> . OR<br>As time increases from 13:00 to 21:00, the <u>amount of light intensity decreases</u> , hence <u>rate of photosynthesis decreases</u> .<br><br>With increased uptake of carbon dioxide, there is less atmospheric carbon dioxide<br><br>At 21:00, absence of light means that no photosynthesis occurs.<br><br>Respiration produces carbon dioxide (which is released by leaf into the air) | 1<br><br>1<br><br>1<br>1<br>1 (any 4) |
| (c)                                                                                                                                                                                                                                                                     | a<br><br>b                            | concentration of oxygen increases/ increasing<br><br>With increasing light intensity, rate of photosynthesis is increasing thus producing more oxygen per unit time                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1<br><br>1                            |
| <b>Feedback / Explanation:</b><br>(a) Odd scales will waste your time during plotting of points, and increases your chances of plotting wrongly.<br>(b) It is important to note that respiration rate is constant and happens all the time, not only when it gets dark. |                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | [Total: 10]                           |

| Q 10                                                                                                                                                                                                                                                                                                                                      |   | Answer                                                                                                                                                            | Guidance         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| (a)                                                                                                                                                                                                                                                                                                                                       | a | Hydrogen ions are <u>hydrophilic / charged / non-lipid soluble</u> .                                                                                              | 1                |
|                                                                                                                                                                                                                                                                                                                                           | b | Hydrogen ions will be repelled / impeded by <u>hydrophobic fatty acids</u> (tails) / the <u>hydrophobic core</u> of the bilayer                                   | 1                |
|                                                                                                                                                                                                                                                                                                                                           | c | Hydrogen ions require a <u>transport / carrier / channel protein</u> to pass through                                                                              | 1<br>Max 2       |
| <b>Feedback / Explanation:</b><br><br><b>Reject:</b> <ul style="list-style-type: none"> <li>• phospholipid bilayer is mostly hydrophobic</li> <li>• hydrogen ions are polar molecules</li> <li>• hydrogen ions are found in water molecules</li> </ul> Many candidates are unable to distinguish between ions, molecules, polar molecules |   |                                                                                                                                                                   |                  |
| (b)                                                                                                                                                                                                                                                                                                                                       |   | <u>Similarities</u> <b>Max 3</b>                                                                                                                                  |                  |
|                                                                                                                                                                                                                                                                                                                                           | a | Both require <u>membrane protein</u>                                                                                                                              | 1 R protein pump |
|                                                                                                                                                                                                                                                                                                                                           | b | Both involve <u>protein with binding sites</u> .                                                                                                                  | 1 R active site  |
|                                                                                                                                                                                                                                                                                                                                           | c | Both transport <u>specific</u> / can transport <u>hydrophilic / charged / non-lipid soluble</u> substances (across membrane).                                     | 1                |
|                                                                                                                                                                                                                                                                                                                                           | d | Both involve movement of substances between regions with differences in <u>concentrations</u> (across membrane).                                                  | 1                |
|                                                                                                                                                                                                                                                                                                                                           | e | Both occur across a <u>membrane / phospholipid bilayer</u> (structure).                                                                                           | 1                |
|                                                                                                                                                                                                                                                                                                                                           |   | <u>Differences</u> <b>Max 3</b>                                                                                                                                   |                  |
|                                                                                                                                                                                                                                                                                                                                           | f | Active transport move substances <u>against concentration gradient</u> , while facilitated diffusion move substances <u>along / down concentration gradient</u> . | 1                |

|                                                                                                                                                                                                                                                                                                                                                |          |                                                                                                                                                                                                                 |                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
|                                                                                                                                                                                                                                                                                                                                                | <b>g</b> | Active transport requires (metabolic) <u>energy</u> , while facilitated diffusion does not require (metabolic) energy. OR active transport is an active process while facilitate diffusion is a passive process | <b>1</b>                 |
|                                                                                                                                                                                                                                                                                                                                                | <b>h</b> | Active transport require <u>protein pump</u> /carrier proteins, while facilitated diffusion does not involve <u>protein pump</u> / involves carrier proteins or channel proteins                                | <b>1</b><br><b>Max 5</b> |
| <b>Feedback / Explanation:</b><br><br>The following incorrect description can be found in a substantial number of responses.<br>“Active transport <i>is from low to high concentration</i> while facilitate diffusion <i>is from high to low concentration</i> ”<br><br>Candidates who did not make comparison will not be awarded full marks. |          |                                                                                                                                                                                                                 |                          |
| <b>(c)</b>                                                                                                                                                                                                                                                                                                                                     | <b>a</b> | Root hair cells have <u>numerous mitochondria</u> / perform <u>a lot respiration</u> , hence <u>release (high amount of) energy</u> .                                                                           | <b>1</b>                 |
|                                                                                                                                                                                                                                                                                                                                                | <b>b</b> | Root hair cells absorb ions by <u>active transport</u> into its cell sap / cytoplasm.                                                                                                                           | <b>1</b>                 |
|                                                                                                                                                                                                                                                                                                                                                | <b>c</b> | The water potential of <u>cell sap / cytoplasm</u> of root hair cells is <u>more negative</u> than the soil (solution). OR ensure a <u>steep water potential gradient</u>                                       | <b>1</b>                 |
|                                                                                                                                                                                                                                                                                                                                                | <b>d</b> | Water <u>molecules</u> move (into) from soil (solution) into cell sap / cytoplasm of root hair cells by <u>osmosis across selectively permeable membrane</u> .                                                  | <b>1</b>                 |
|                                                                                                                                                                                                                                                                                                                                                | <b>e</b> | Hence, there is a <u>continual / constant</u> absorption of water (and ions) into the <u>xylem</u> .                                                                                                            | <b>1</b><br><b>Max 3</b> |
| <b>Feedback / Explanation:</b><br>Candidates who described the presence of large central vacuole in the root hair cell to store a high concentration of ions have also been awarded the mark.<br>A common misconception is to describe a steep concentration gradient as a means to increase the rate of active transport.                     |          |                                                                                                                                                                                                                 | <b>[Total: 10]</b>       |

| Q 11<br>E                                                                                                                                               |                                                                              | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Guidance  |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------|------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------|-----------------------------------|-------------------------------------------------|------------------------------|-----------------------------|-------------------------------------------------------------------------------|
| (a)                                                                                                                                                     |                                                                              | <table><tr><th>Meiosis</th><th>Mitosis</th></tr><tr><td>homologous chromosomes pair up at metaphase plate/ equator of the cell</td><td>chromosomes line up in single file at the equator of the cell/ metaphase plate</td></tr><tr><td>crossing over occurs between non-sister chromatids of homologous chromosomes</td><td>crossing over does not occur</td></tr><tr><td>chromosomes line up at the metaphase plate/equator twice</td><td>chromosomes line up at the metaphase plate/equator once</td></tr><tr><td>Independent assortment of homologous chromosomes occur</td><td>Independent assortment of homologous chromosomes do not occur</td></tr><tr><td>homologous chromosomes move apart</td><td>sister chromatids of the chromosomes move apart</td></tr><tr><td>chromosomes decondense twice</td><td>chromosomes decondense once</td></tr></table> | Meiosis   | Mitosis | homologous chromosomes pair up at metaphase plate/ equator of the cell | chromosomes line up in single file at the equator of the cell/ metaphase plate | crossing over occurs between non-sister chromatids of homologous chromosomes | crossing over does not occur | chromosomes line up at the metaphase plate/equator twice | chromosomes line up at the metaphase plate/equator once | Independent assortment of homologous chromosomes occur | Independent assortment of homologous chromosomes do not occur | homologous chromosomes move apart | sister chromatids of the chromosomes move apart | chromosomes decondense twice | chromosomes decondense once | <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> |
|                                                                                                                                                         | Meiosis                                                                      | Mitosis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | homologous chromosomes pair up at metaphase plate/ equator of the cell       | chromosomes line up in single file at the equator of the cell/ metaphase plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | crossing over occurs between non-sister chromatids of homologous chromosomes | crossing over does not occur                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | chromosomes line up at the metaphase plate/equator twice                     | chromosomes line up at the metaphase plate/equator once                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | Independent assortment of homologous chromosomes occur                       | Independent assortment of homologous chromosomes do not occur                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | homologous chromosomes move apart                                            | sister chromatids of the chromosomes move apart                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | chromosomes decondense twice                                                 | chromosomes decondense once                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
| Feedback / Explanation:                                                                                                                                 |                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
| Responses that do not describe the behaviour of chromosomes (e.g. number of chromosomes, number of nuclei division etc.) will not be awarded the marks. |                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
| (b)                                                                                                                                                     | a                                                                            | Mitosis produces <u>genetically identical cells</u> to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1         |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | b                                                                            | replace damaged/ worn out/ old cells in tissue repair/ repair tissue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1         |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | c                                                                            | <u>increase cell number for growth</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1         |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |
|                                                                                                                                                         | d                                                                            | Mitosis is the basis for asexual reproduction to produce genetically identical offspring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 [max 3] |         |                                                                        |                                                                                |                                                                              |                              |                                                          |                                                         |                                                        |                                                               |                                   |                                                 |                              |                             |                                                                               |

|                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                  |                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| (c)                                                                                                                                                                                                                                                                                                                                                                                                                                      | a | meiosis produces haploid cells/gametes                                                                                           | 1                                                                                            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                          | b | restores the diploid number of the organism upon fertilisation/ prevents doubling of the chromosomal number with each generation | 1 importance of haploid cells must be accompanied with genetic stability of the species<br>1 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                          | c | meiosis introduces genetic variation in the gametes                                                                              | 1 genetic variation must be accompanied with                                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                          | d | species is better adapted to the environment                                                                                     | better adapted to the environment<br>1                                                       |
| <div> <b>Feedback / Explanation:</b> <div>[Total: 10]</div> <p>A number of candidates have the misconception that random fertilisation happens during meiosis or are unable to make the distinction between these two processes. The idea of adaption of species needs to be explained with greater clarity. Responses that make reference to <i>organisms changing to adapt</i> to environment will not be awarded the mark.</p> </div> |   |                                                                                                                                  |                                                                                              |

| Q 11<br>O |   | Answer                                                                                                                                                       | Guidance |
|-----------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| (a)       | a | carbon enters the leaves in the form of carbon dioxide. <u>Carbon dioxide</u> in the air <u>diffuses</u> into the <u>intercellular airspaces</u> in the leaf | 1        |
|           | b | through <u>the stomata</u>                                                                                                                                   | 1        |
|           | c | carbon dioxide <u>dissolves in the thin film of moisture</u> on the spongy mesophyll cells                                                                   | 1        |
|           | d | carbon dioxide <u>diffuses into the mesophyll cells</u> for <u>photosynthesis</u>                                                                            | 1        |
|           | e | light is absorbed by <u>chlorophyll in chloroplasts</u>                                                                                                      | 1        |
|           | f | for the photolysis of water/ light energy is converted into chemical energy for the synthesis of glucose from carbon dioxide and water                       | 1        |
|           | g | carbon dioxide is reduced by H <sup>+</sup> / NADPH to form glucose                                                                                          | 1        |
|           | h | <u>excess</u> glucose is then stored as starch                                                                                                               | 1 max 6  |



